Aug 8 1957

Design Engineering

FIVE DOLLARS A YEAR

eeve bearings.p.37

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aluminum castings..p.27

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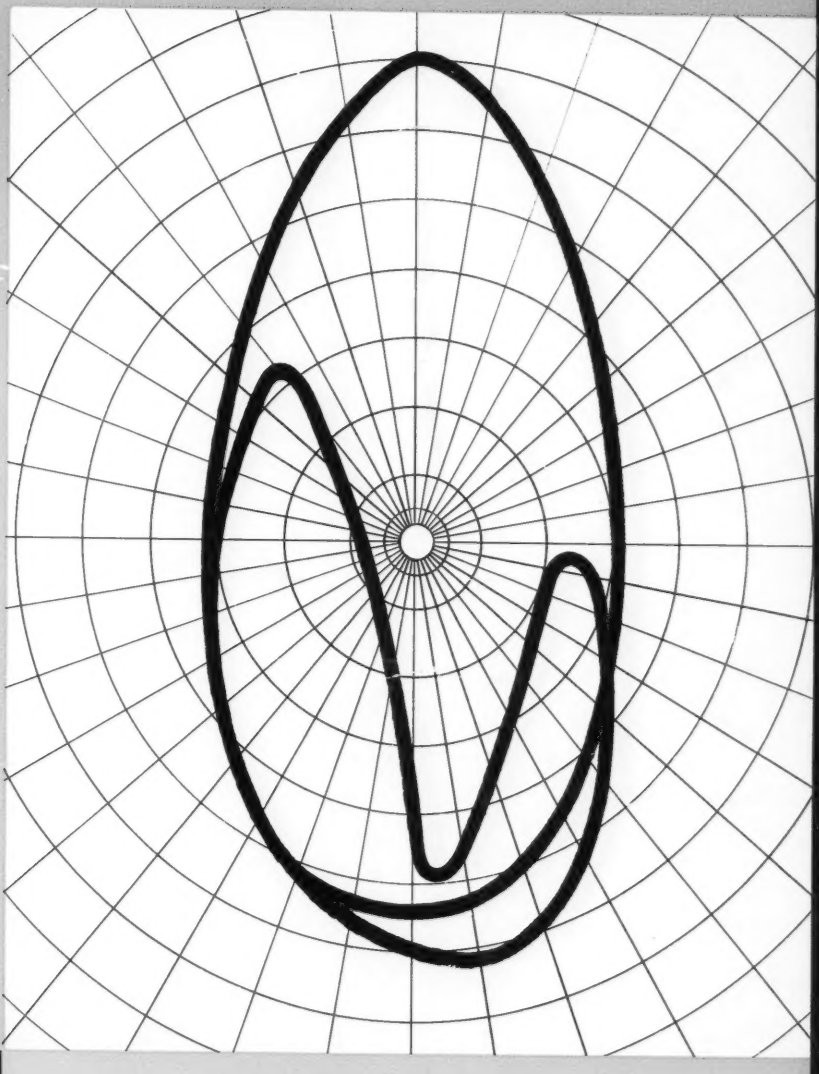
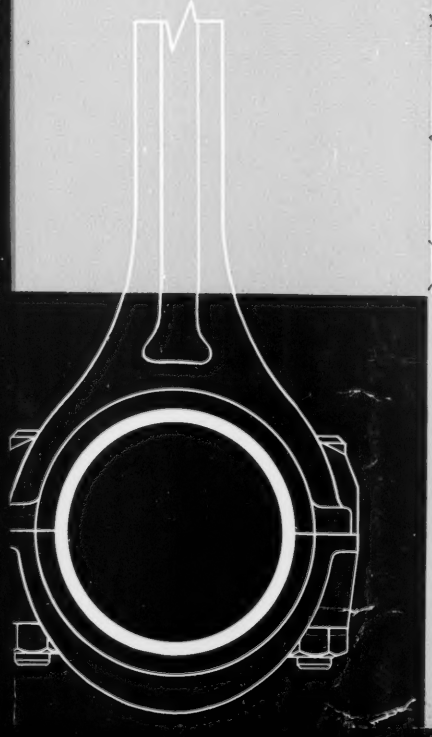
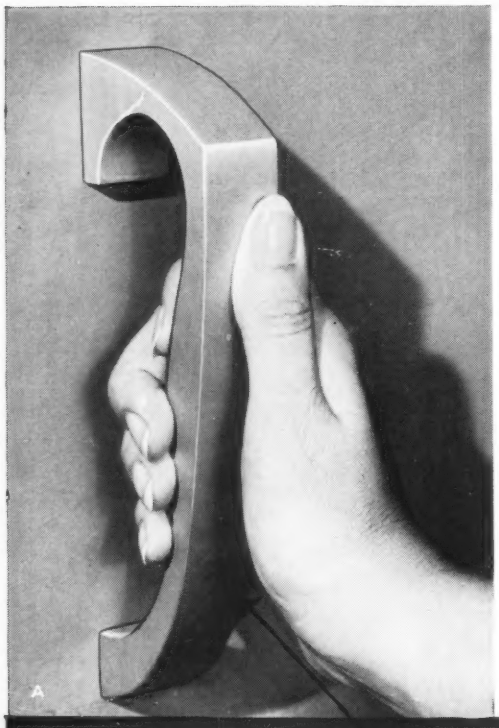




August 1957

Open the door to new freedom in design with
ALCAN ALUMINUM EXTRUSIONS

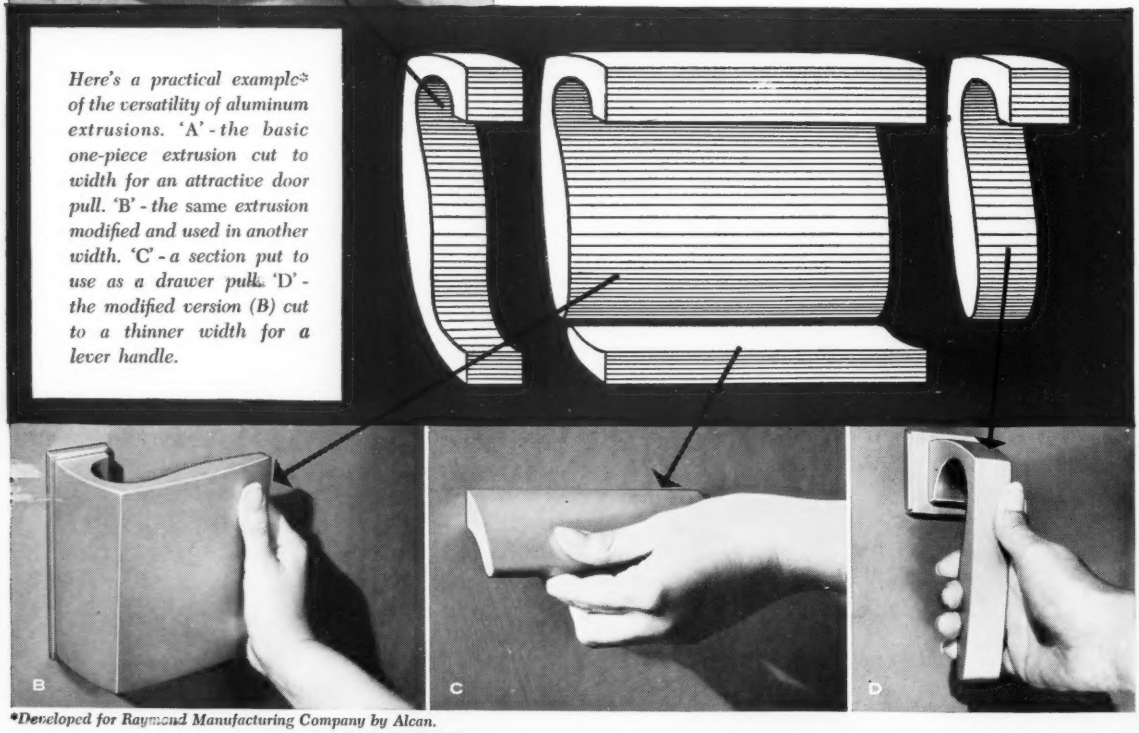


Offering a limitless variety of shapes and sizes, Alcan Aluminum Extrusions can help you improve your products and reduce costs.

Alcan aluminum extrusions have the uniformity and close tolerances that reduce assembly machining time. Labour, material and assembly costs are further cut because one-piece extrusions eliminate costly joining operations.

Alcan aluminum extrusions find a hundred and one applications in furniture, household appliances, machinery, motors, toys, and end products of all kinds. For full information on standard or special shapes to meet your requirements, call your Alcan Sales Office.

Here's a practical example of the versatility of aluminum extrusions. 'A' - the basic one-piece extrusion cut to width for an attractive door pull. 'B' - the same extrusion modified and used in another width. 'C' - a section put to use as a drawer pull. 'D' - the modified version (B) cut to a thinner width for a lever handle.*



**Developed for Raymond Manufacturing Company by Alcan.*

ALCAN

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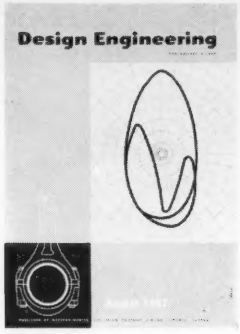

Design Engineering

VOL. 3 AUGUST 1957 No. 8

This month's cover

Gerald Bern returns to the cover artist's chair in the August issue with a black and blue rendering of the feature article on sleeve bearings which starts on page 37. Apart from the readily recognizable big-end bearing at the lower left there is a graph with a Gioconda smile. This is not just a Bern whim but is in fact the rod diagram which can be seen again in less glamorous surroundings on the second page of the article (p. 38).

Design Engineering

MEMBER

CCAB

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Printed and published by Maclean-Hunter Publishing Company Limited, Editorial and Advertising Offices: 212 King Street West, Toronto 2, Canada. Address all correspondence: P.O. Box 100, Toronto, Canada. Horace T. Hunter, Chairman of the Board; Floyd S. Chalmers, President; Donald F. Hunter, Vice-President and Managing Director; Thomas H. Howse, Vice-President and Comptroller.

Publishers of National magazines in Canada: Maclean's, Chatelaine, Canadian Homes and Gardens, Business newspapers in Canada: Canadian Hotel Review; Fountains in Canada; Heating and Plumbing Engineer; Bus and Truck Transport; Canadian Advertising; Canadian Automotive Trade; Canadian Aviation; Canadian Grocer; Canadian Machinery; Canadian Packaging; Canadian Paint and Varnish; Canadian Printer and Publisher; Canadian Shipping; Canadian Stationer; Civic Administration; Drug Merchandising; Electronics Engineering of Canada; L'Epicier; The Financial Post; Hardware and Metal; Marketing; Men's Wear; Modern Power; Painting and Decorating Contractor; Plant Administration; Le Quincaillier; Electrical Contractor; Style; Office Equipment & Methods; Home Goods Retailing; Photo Trade; Building Supply Dealer; Business newspapers in U. S. and U. K.: Inland Printer, Rock Products, Concrete Products, British Printer.

OTHER SERVICES: The Financial Post Corporation Service; Canadian Press Clipping Service; Commercial Printing Division.

Offices at 1242 Peel Street, Montreal; Maclean-Hunter Limited, 125 Strand, London (Eng.).

Subscription rates: Canada $5.00 per year, two years $9.00, three years $13.00. Single copy price, $1.00. Other countries $8.00 per year.

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from this to this... in 3/5 of a second!*

Two elements—the rugged, inexpensive FINGRIP, and the fully automatic, easily-loaded TERMATIC—form the new Burndy FINGRIP METHOD, permitting a speed and ease of uniform electrical termination never before possible. NO PEDALS OR LEVERS TO PRESS, and no pre-positioning of wire necessary—insertion of the wire end actuates the TERMATIC, virtually eliminating rejects and minimizing operator fatigue. The machine is quickly and easily loaded (less than 15 seconds) and is completely enclosed for operator's protection. The FINGRIP, an inexpensive, quick-disconnect terminal, has FOUR individual pressure elements—permitting greater flexibility and abuse without damage.

Write Burndy Canada Ltd., 1530 Birchmount Road, Scarboro, Ont. for general information or for solutions to specific terminal problems. Our engineers are always available for personal consultation.

*6000 per hour by actual customer test.

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Design Engineering

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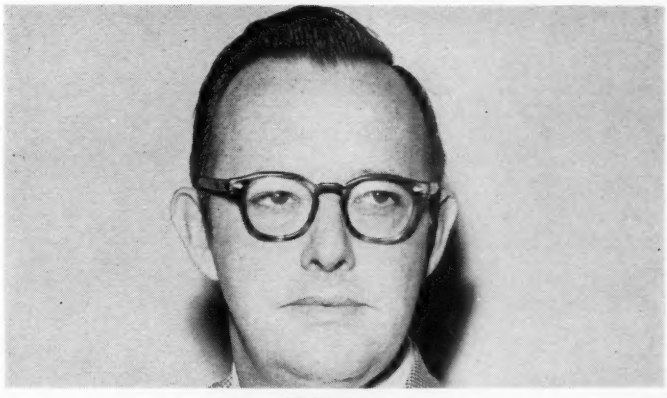
1. Permanent magnet materials.
2. High temperature microscopy.
3. X-ray testing.
4. Brazing stainless.
5. Midget tape recorder.
6. Spectrography.
7. Nickel alloy coating.
8. IRE Show preview.
9. Hydraulic pumps.
10. Crash-proof car.

Maloney

Thomas J. Maloney (How are sleeve bearings designed for optimum performance?) is a native of Ohio and a graduate metallurgical engineer from Case Institute of Technology. Following a brief session in an alloy steel mill he joined the USAF and, after an aircraft maintenance course at Yale, was 2½ years in India on the "Hump" operation to China. He has been engaged in bearing research and development for 8 years and field and product engineer at Clevite Ltd. since 1954.

Woodward

Mr. John Woodward (Clad metals conserve expensive alloys) got his AB degree from Bowdoin College in 1941 and an MBA from the school of business administration at Harvard University a couple of years later. '43-'46 saw him in the Navy and, on discharge, he joined the time study and methods department of Metals and Controls Corp. Two years later he entered the industrial sales department. His most recent appointment, marketing manager of the general plate division,

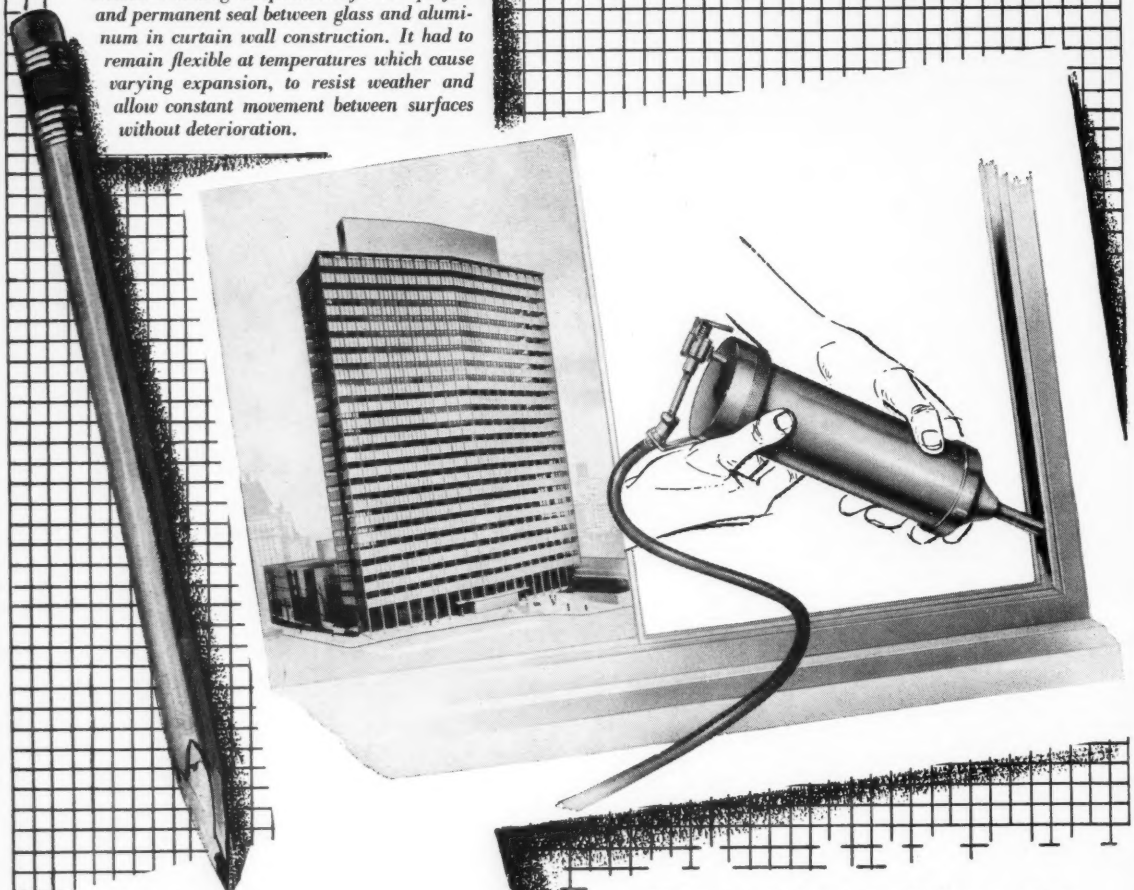


McCartney

Todd McCartney (Fluid couplings are tougher than ever) is application engineer for Parker Aircraft Co. He has followed the development of his company's MS flareless tube fitting project through from its conception right up to the present. Such being the case, he is a natural for the article, especially since he has considerable past experience with the unit in the departments of design, quality control and application engineering. In his article, he explains the MS fitting and why it rates use on high-performance aircraft.

Problem:

North Western Supply Company, of Vancouver, needed a sealing compound to form a perfect and permanent seal between glass and aluminum in curtain wall construction. It had to remain flexible at temperatures which cause varying expansion, to resist weather and allow constant movement between surfaces without deterioration.



Solution:

Polysar Butyl 301 proved to be the answer to North Western's exacting sealing problem. As the base for Norwescoseal 566, Polysar Butyl 301 imparts the essential qualities of permanent adherence in all weather between the sealing compound and materials of varying physical qualities under repeated flexing.

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There is a wide variety of Polysar synthetic rubbers from which to select the one best suited to a particular application. The Sealant, based on Polysar Butyl 301 is just one example of the many uses for these rubbers. In countless industries—myriads of products are being improved and enlarged upon by Polysar synthetic rubbers.

Regardless of your field, it may be that Polysar synthetic rubber can solve your technical problem. Write to our Sales and Technical Service Division, Polymer Corporation Limited, Sarnia, Canada.

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Reports

News in brief from the world's producers

Fused-film wire

Announced recently by **Adam Consolidated Industries, Inc.,** the formation of a new subsidiary to manufacture an exclusive process for applying a thin film of insulation to copper wire. This may revolutionize the design of electrical components in airborne, electronic, appliance and other industries.

The new process (known as Fused-film wire) uses Teflon to produce a thin film of insulation 0.002 in. thick that has unusually high degrees of dielectrical strength, as well as heat, scrape, water, chemical and fungus resistance.

Despite its thin-walled insulation, the wire can withstand high voltages and temperatures without failure, and can be formed into complex shapes, making it possible to design smaller units with greater electrical output.

Industrial scales

Advanced designs of industrial scales are now available to the Canadian buyer from **W. and T. Avery, Ltd.**

This new CFA combination lever and spring dial mechanism is the first of its kind to meet Canadian Bureau of Standards approval. It is an advancement over the old double pendulum mechanism, has a hysteresis factor of 1-4,000, maintains remarkable accuracy, is completely shock proof and requires very little maintenance. Other features are: shadowless indication, vertical figures, a 28-in. diameter reading line and shallow economical foundations.

Engineering technicians

The first official certification of engineering technicians in Canada was carried out recently when Premier Leslie Frost presented certificates to six men who had qualified.

The ceremony, held in the Council Chambers of the Parliament Buildings at Queen's Park, was atteneded by officials of the **APEO** including John H. Fox, P.Eng. (Toronto), Association president; Dr. George B. Langford, P.Eng. (University of Toronto) and Blake H. Goodings, P.Eng. (Association field representative).

The 16,000-member Association was the first engineering body in Canada to establish a plan to certify technicians in five grades.

At the ceremony the Premier presented engineering technician certificates to Ivan Malyk, Toronto (grade 1); Peter Sulman, Port Perry (grade 3); John A. Christopher, Niagara Falls (grade 4); Robert M. Barnes, Toronto (grade 4) and Evaneglos Logothetis, Toronto (grade 5).

Premier Frost said he felt great satisfaction in knowing that the idea for certification of technicians originally came from his office.

High altitude suit

Test pilots and flight test engineers are now wearing a new Canadian high-altitude suit.

Developed by the **Institute of Aviation Medicine,** the suit is still under development. Orenda crews are working with the Institute to test it under actual operating conditions.

The suits are a safety measure to give pilots time to reduce altitude. In the event of the cabin's air pressure system failing above 48,000 ft, the crew finds it extremely difficult to breathe, even when oxygen is fed into the face mask under pressure. The suit allows normal breathing for a short period.

Steel mill

A $3-million package of tailor-made electrical equipment has been ordered by **Algoma Steel Corporation** from the Canadian Westinghouse Company, for the first card-programed automatic steel mill to be built in Canada. The order is the largest ever placed with a single electrical apparatus manufacturer by a Canadian steel company.

The new combination plate and blooming mill will be ready for production by early 1959 at Sault Ste. Marie, Ontario. Part of a major expansion program, it will be the largest of its kind in this country and will turn out a wide product range. The card programing is to be adapted initially for automatic thickness control and engineered for wider application in the future.

Sleeve bearings

Seven straight years of daily battling the dust and grime that only a gravel conveyor can produce, and the bronze sleeve bearings involved continued to function perfectly. That's the experience of a large Canadian producer of concrete blocks.

The story started some seven years ago when J. Cooke (Concrete Blocks) Ltd. of Aldershot, Ont., installed 20 huge outdoor conveyors and equipped them with bearings made by the **Amplex Division of Chrysler.**

After seven years, not one of these bearings has had to be replaced. They all function as well as they did when originally installed.

Steel wheels

Formation of a new Canadian company —**Canadian Steel Wheel Limited**—was announced last month by Canadian Steel Foundries (1956) Limited of Montreal and English Steel Corp. of Sheffield, England.

The new company was established to manufacture wrought steel railway wheels, a first for Canadian industry. Production is scheduled at 200,000 wheels a year.

Speed increaser

Designed, built and tested by by **Dominion Engineering Co. (Diesel Division):** a new type of speed increaser for use with their Model 244 and 251 diesel engines. The gear unit (which is mounted directly onto the rear of the engine) is complete with its own built-in flexible coupling and lub. oil system, and has been designed basically for use on diesel engine driven centrifugal pumping units.

Premier Frost and APEO's Fox congratulate technician Christopher (see left).

Gas bearings

Where it may be impracticable to use conventionally lubricated bearings, it is sometimes possible to use a gas for this purpose.

The two basic classes of gas lubricated bearings (of both journal and thrust types) are the hydrostatic, and the self-acting or hydrodynamic. In the former, the load is sustained by the hydrostatic pressure of gas in the clearance space between the two elements of the bearing.

Hydrodynamic bearings generate their own hydrostatic pressure in the clearance space, because of the viscosity of the fluid in which they are immersed and the relative motion of the bearing elements.

Scholarships

An increase in the number of four-year undergraduate scholarships, in **The International Nickel Company of Canada's** program for aid to higher education, was announced today by John F. Thompson, chairman, and Henry S. Wingate, president of the company.

In addition to the forty scholarships awarded by the company last fall for the four-year academic period ending June 1960, 25 more will be awarded in September 1957 and the same number each succeeding year until the total is 100.

Digital computer

An IBM-650 digital computer—the first to be installed in any Canadian industry outside the defense field—is now in operation at the Peterborough works of **Canadian General Electric Co. Ltd.**

By performing automatically many calculations previously done manually on slide rules, the computer is releasing engineers for more creative work.

The computer is being used to assist engineers in their design calculations on a variety of product lines.

In design work (company officials say) the computer—because of its low cost and great speed of calculation—allows the consideration of more design alternatives before a final design is chosen. The computer has already shown that it will permit the designing and building of better products in less time by allowing engineers to arrive at the optimum design by using material to the best advantage.

Light metals chart

Of very great interest to all engineers who have anything to do with the selection of aluminum and magnesium is a "just off the press" slide chart being brought out by **Alloy Metal Sales Ltd.** Packed in a 13½-in. x 10-in. area the company has put out a veritable encyclopaedia on these metals and, for assured accuracy, has had the material checked and okayed by the big aluminum suppliers. Among the data: sizes available, anodizing properties, typical uses, tensile and yield strengths, machinability, weldability and so on.

Next month in Design Engineering

SEPTEMBER

X-ray testing—The article shows that this is not merely a device for detecting flaws. It has become a production tool for checking close tolerances in intricate assemblies.

Permanent magnet materials—A brief historical background followed by a review of the permanent magnet material now available to the product designer.

High temperature microscopy—Method used for investigating the transformation taking place when metals, alloys and nonmetallic materials are heated.

Hydraulic pumps—Details of a range of hydraulic pumps and motors developed from the Lucas fuel injection pump.

Spectrography—How the spectrograph is used for identifying chemical elements by recording a spectrum of lines on a photographic film.

Other features will deal with the crash-proof car, brazing stainless and a method of applying nickel-alloy coatings.

Trends

Aircraft materials

Speakers at a recent meeting of the ASME in San Francisco predicted that tomorrow's aircraft, flying so fast that air friction will heat them to temperatures of 1,200 F (or more), will have to be made by completely new manufacturing methods and of materials only now being developed.

To overcome this problem, new alloys of titanium and steel are being developed that are relatively immune to heat and fairly light in weight. Use of such materials, however, will require new manufacturing methods, since the new alloys are much more difficult to shape into usable forms than today's metals.

Fir plywood

Many industry leaders believe the volume of fir plywood going into industrial applications may soon approach that being used in the more traditional field of construction. Among examples of large-volume industrial uses are: pallets; mountings; mock-ups of cars, planes and machinery; truck and freight car linings; crating and packaging; chemical tanks.

This is due to plywood's combination of light weight with great strength, as well as to its impact resistance and ease of fabrication. Economy can also be a decisive factor when costs are compared with those of alternative materials.

Chemically created materials

A recent S.A.E. paper dealt with types and forms of chemically created materials for automotive engineering (H. A. Hoppens).

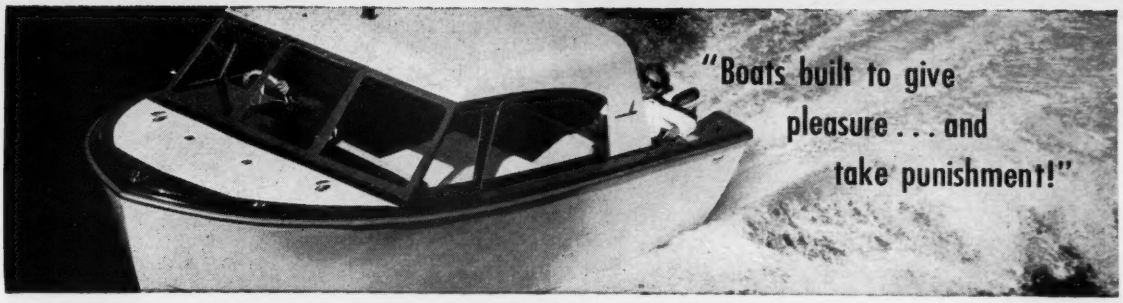
Remelting furnace

The toughest metals known to man have moved a step nearer industry-wide production by the development of a new furnace.

Known as a consumable electrode vacuum remelting furnace, it melts titanium, zirconium, high alloy steels and other ferrous or nonferrous alloys. The resultant metals are remarkably free from impurities and possess improved properties.

Cermets

At present, practically all the materials produced as cermets are made for experimental usage with no type being made by more than one manufacturer. A committee just set up by the ASTM will endeavor to promote information on the subject in the form of papers, meetings and symposiums. Its first problems will be to study commercial progress in order to know when test methods and product standards are desired.



● Bumps and bruises that would often splinter an ordinary craft are shrugged off by these sturdy boats made with RCI POLYLITE polyester resin. Plastic Fabrications, Inc., Miami, Florida, reports that the inherent resiliency of RCI POLYLITE reinforced with fibrous glass allows a hull to "give" under pressure instead of offering stiff resistance — thus improving the overall strength and safety factor of their products.

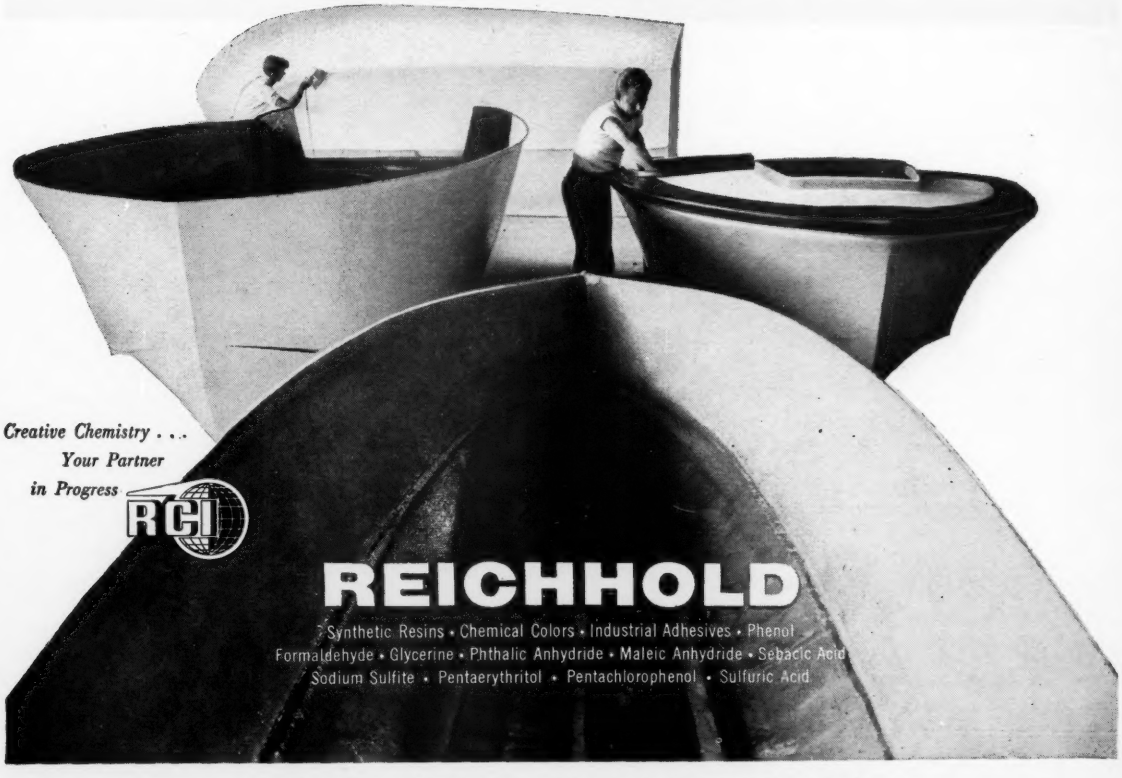
In addition, a molded boat permits more attractive and complicated hull and deck structure — usually expensive features — at reasonable cost . . . and eliminates sharp edges that are dangerous in angry waters.

"In production, our primary requirement is a base material with consistent formulation," says J. A. "Woody" Woodson, Plastic Fabrications' president, in explaining why his firm uses RCI POLYLITE. "The curing and weathering characteristics must not vary from batch to batch. If a resin does not cure, our time and labor is lost and the section must be discarded."

"Another 'plus' for Reichhold POLYLITE," continues Mr. Woodson, "is *dependable* distributor arrangements. Our POLYLITE orders are delivered *on time*, so that costly production delays are a thing of the past."

Products possessing the unique advantages possible with RCI POLYLITE — lightweight strength, durability, and easy maintenance — are becoming increasingly popular and profitable in today's market. For additional information about how RCI POLYLITE can be incorporated into one of *your* products by laminating, molding or other plastic applications, write for free ***Booklet A.***

Constructed economically with
UNIFORM QUALITY **POLYLITE** RESINS



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Garlock "makes the grade" with Galion... for over 30 years

Now celebrating their 50th Anniversary, the Galion Iron Works and Mfg. Co., of Galion, Ohio is a leader in its field, and Galion Road Rollers and Motor Graders enjoy a reputation for long life and easy operation. For 30 years Garlock CHEVRON* Packings have been selected for the hydraulic cylinders of both Galion Road Rollers and Motor Graders. In fact, all eight models of the Motor Grader use CHEVRON Packings exclusively on hydraulic cylinders operating the blade, leaning front wheel, booster steering and various attachments.

The distinctive and exclusive CHEVRON design is extremely sensitive to pressure changes and ideally suited to use in shallow stuffing boxes. As pressures increase the CHEVRON Packing Rings automatically tighten to prevent leakage. As pressures decline the CHEVRON Rings instantly ease off permitting free operation without leakage. That's why cylinders using CHEVRON Packings require minimum attention and maintenance.

Exclusive CHEVRON is one more part of "the famous Garlock 2,000"... two thousand different styles of packings, gaskets, and seals for every need—the only complete line. It's one reason why your Garlock representative can provide you with unbiased recommendation. Call him today or write for CHEVRON Folder AD-115.

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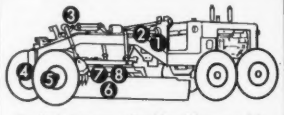
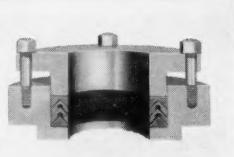


Garlock CHEVRON Packing Rings used in 8 hydraulic cylinders on Galion Motor Graders:

1. Left Blade Lift Cylinder
2. Right Blade Lift Cylinder
3. Scarifier Cylinder
4. Leaning Wheel Cylinder
5. Booster Steering Cylinder
6. Moldboard Shift Cylinder
7. Tilt Moldboard Cylinder Right
8. Tilt Moldboard Cylinder Left



This design is entirely different from ordinary V-type packing. CHEVRON has an exclusive construction which assures the automatic action for which it is designed. Also permits the use of less packing in shallower stuffing boxes.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals
Rubber Expansion Joints, Fluorocarbon Product

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ATLAS STEELS

ATLAS STEEL NEWS

TOOL STEELS • HIGH SPEED STEELS • MINING DRILL STEELS • SPECIAL PURPOSE STEELS • STAINLESS STEELS

New Atlas Tool Steel Grades Offer Exceptional Resistance to Abrasion

Atlas M3 and M4 mean better performance for a wide range of cutting tools

Atlas Steels Limited have recently announced two entirely new grades of high speed tool steel for special applications. The first, called type M3, is primarily designed for superior abrasion resistance with a minimum sacrifice of toughness. M3 also offers good edge life of cutting tools, plus grindability.

The second new Atlas grade is type M4. Its abrasion resistance is even better than the M3. In addition, M4 gives exceptionally good cutting ability to such tools as form cutters, broaches and reamers. It is more readily ground than the high carbon, high vanadium, cobalt class of high speed steels and its toughness compares favorably with other high speed types. M4 also performs well on certain cold work punches and dies requiring high abrasion resistance and better toughness than standard high carbon, high chrome die steels. It should, of course, be used only for tools of relatively simple design, permitting the use of a high hardening temperature.

TYPICAL USES

M-3	M-4
• Hobs	• Reamers
• Taps and Dies	• Broaches
• Reamers	• Form Cutters
• Counter Bores	• Hobs
• Broaches	• Forming Rolls
• Form Tools	• Milling Cutters
• Lathe, Planer, Boring Tools	• Drills, Punches
• Milling Cutters	• Lathe and Planer Tools
• Drills	• Taps, Chasers (non-ferrous metals)
• Blanking and Punching Dies	

ATLAS STEELS LIMITED

WELLAND, ONTARIO

WAREHOUSES: MONTREAL, TORONTO, HAMILTON, WINDSOR, WINNIPEG, VANCOUVER.

REPRESENTATIVES IN LONDON, ST. CATHARINES AND SUDBURY

NEW STEEL GRADES MADE-TO-ORDER

Three special induction melting furnaces at Atlas enable our metallurgists to create and experiment at reasonable cost with "custom formulated" steels to meet unusual specifications. The smallest test heat possible in a regular electric arc furnace is 5 tons, but the small induction units will handle heats of 600, 350 or 100 pounds. This facility permits Atlas to offer a very valuable customer service—steels made-to-order by combining alloy elements in economical small "batches".

Photo shows operator about to drop accurately weighed alloy material into opening in top of furnace. Flame at right is from burner unit which pre-heats tundish prior to pouring of molten metal.

Atlas and Rock Drill Rod Co. Ltd.— A Canadian Success Story

A few years ago, no one in Canada was manufacturing a complete line of pneumatic tools for rock drilling, concrete and frost breaking, hard clay digging, metal chipping and cutting and demolition work. Local users had to depend largely on imports from the U.S. and overseas.

John Suchanek, an enterprising Canadian who emigrated from Czechoslovakia in 1939, saw the need and formed Rock Drill Rod Co. Ltd. in Toronto. Mr. Suchanek was confident that he could compete with the imports on a quality basis.

In less than four years Rock Drill Rod's Toronto plant has tripled its production and a Montreal branch has been opened to handle requirements in the province of Quebec.

For the quality raw materials, Mr. Suchanek emphatically specifies Atlas Steels.

"No other steels I have used can match the consistently uniform quality of Atlas products," he says.

NEW GOLDEN BONDERITE for Aluminum

Uniform color means uniform coatings and uniform efficiency

It's the simplest thing in the world to check on the efficiency of a Golden Bonderite installation. Just look at the color of the aluminum as it comes out of the Bonderite machine. The uniform golden coating looks the same—and it is the same—24 hours a day, seven days a week.

Golden Bonderite sets entirely new standards of efficiency and performance as a paint base for aluminum and its alloys. Operated with the Parker "Reactifier," the Golden Bonderite solution can be used indefinitely, ending the costly necessity of dumping the bath at frequent intervals. Normal chemical replenishment keeps the Golden Bonderite solution in continuous balance.

This ease and certainty of achieving uniformly excellent results means real savings for aluminum fabricators.

It guarantees an effective base for paint.

It breaks the finishing line production bottleneck.

It saves money on chemicals.

It saves money on rejected parts and minimizes field calls because of finish failures.

There are no limitations on the use of new Golden Bonderite. It may be applied by spray or immersion. Treatment cycles can be set to suit production speed and equipment.

Samples of Golden Bonderite-treated aluminum, plus test data, are available for your inspection. Write or call.

How Parker "Reactifier" Works

In conventional surface treatments of aluminum, work passing through the solution causes a buildup of impurities. As impurities increase, solution efficiency decreases until there's nothing to do but dump the bath and start over.

The Parker "Reactifier" removes these impurities as fast as they are formed in the Golden Bonderite solution. Constant circulation of the Golden Bonderite through the exclusive "Reactifier" means a balanced, efficient solution that can be used indefinitely.

Write for Bulletin in COLOR!

Get your copy of the descriptive bulletin on Golden Bonderite and its companion, Green Bonderite, for aluminum. It's new!

Since 1914—leader in the field

PARKER RUST PROOF COMPANY OF CANADA LTD.
Rexdale Blvd., Rexdale (Toronto), Ontario

BONDERITE	BONDERITE and BONDERLUBE	PARCO COMPOUND	PARCO LUBRITE	TROPICAL
corrosion resistant paint base	aids in cold forming of metals	rust resistant	wear resistant for friction surfaces	heavy duty maintenance paints since 1883

**Bonderite, Bonderlube, Parco, Parco Lubrite, —Reg. U.S. Pat. Off.*

This new Guide to Gear Lubrication saves time, money and headaches

FARVAL—
Studies in Centralized Lubrication
No. 195

● If you design, build or use equipment with large gears, you will want Bulletin 60-A. Its 8 pages provide full information on Farval Spray Lubrication Systems available for manual or automatic operation.

Farval Spray Valves are completely flexible. They can be used alone, in panel set-ups mounted on gear housings, or as part of a Farval Dualine System—wherever compressed air is available. As with standard Dualine valves, the spray can be operated as often as needed to deliver any amount of oil or grease—on gears, slide surfaces or other areas needing lubrication.

Thousands of Farval Spray Valves are used in many industries. You, too, should enjoy their benefits. Write today. You will receive a copy of Bulletin 60-A and the address of the Peacock representative in your area who can help you select the proper equipment for your machines. Peacock Brothers Limited, P.O. Box 1040, Montreal 3, Que. Branches in Sydney, Toronto, Sudbury, Winnipeg, Edmonton, Calgary, and Vancouver.

Proved in 30 years of service, Farval manual and automatic centralized lubrication systems protect millions of industrial bearings. Wherever you see the familiar Dualine valve manifolds, dual lubricant lines and central pumping station, you know a machine is being properly lubricated.

FARVAL
CENTRALIZED SYSTEMS OF LUBRICATION

Sold in Canada by...

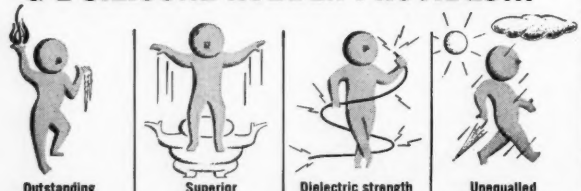
PEACOCK BROTHERS LIMITED

How can you benefit from the AMAZING "COME-BACK" of G-E SILICONE RUBBER?

Amazing recovery from compression is one of the most useful characteristics of General Electric silicone rubber. In fact, Class 300 silicone rubber has more "come-back" over a wider temperature range than any known rubber! That's why designers now use it where compression is a factor. They know that O-rings and gaskets made of Class 300 silicone rubber *resist compression set*—give *more positive* sealing action for better performance!

Where can YOU use G-E silicone rubber? There's a kind for almost every requirement, classified according to dominant property for easy selection and specification. For example: Class 500 offers flexibility *at 120 F below zero!* Class 700 provides serviceability *up to 600 F!* Which class of G-E silicone rubber is best for *you?*

G-E SILICONE RUBBER PROVIDES...



Outstanding resistance to extreme temperatures

Superior resistance to compression set

Dielectric strength stable at high temperatures

Unequalled resistance to aging, ozone, weathering

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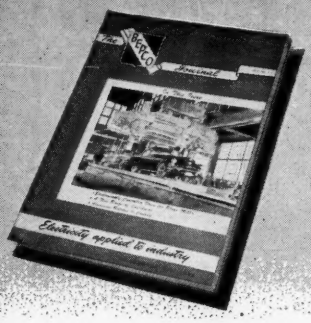

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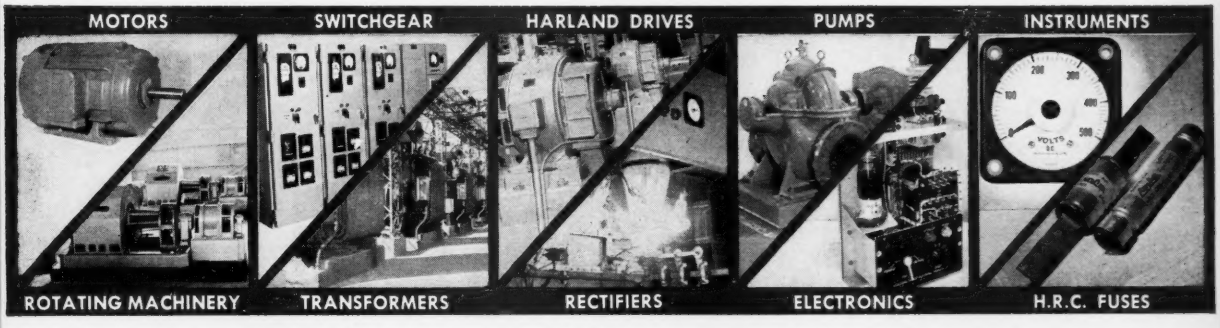

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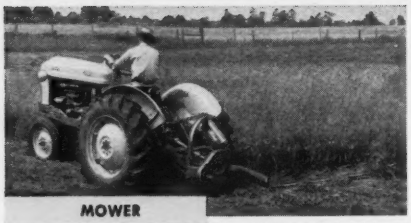

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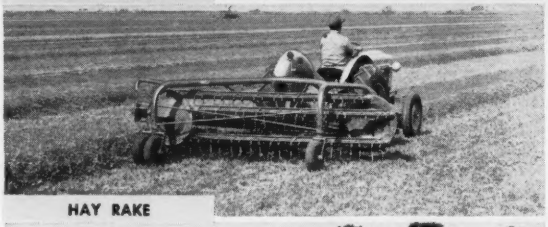
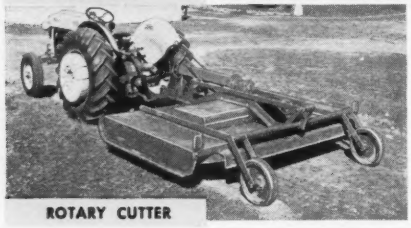
MANURE SPREADER

COMBINE



HAY RAKE



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HAY BALER

CORN PICKER

Yes, these modern Ford Implements are driven through only 3 sizes of

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You'll find important advantages in equipping your implement line with fewer different parts. By working with Blood Brothers' engineers, you can enjoy cooperation to help reduce initial costs and minimize your own engineering expense. Purchasing, stocking and parts cataloging problems, too, are simplified.

And because Blood Brothers Universal Joints deliver the trouble-free, long-lasting service farmers expect, your implements have maximum sales appeal.

Be sure you get the advantages of Blood Brothers engineering, performance and prestige . . . write for full information.

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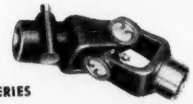

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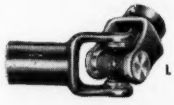

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FOR FARM IMPLEMENTS, MORE BLOOD BROTHERS UNIVERSAL JOINTS ARE USED THAN ALL OTHER MAKES COMBINED

TAKES POWER AROUND CORNERS

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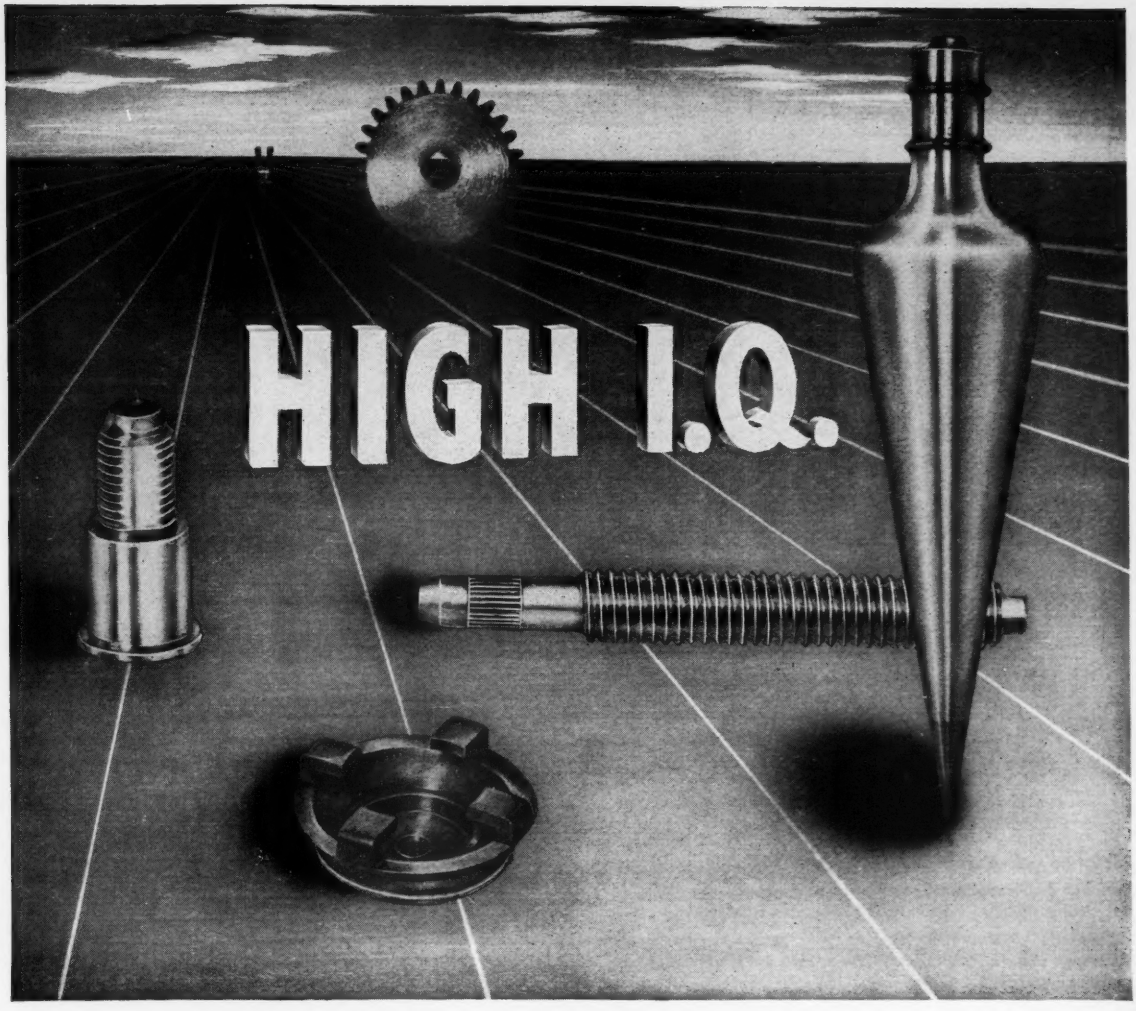

Noranda HIGH I.Q. Free-Cutting Brass Rod

Helps Boost Screw-Machine Production. An exceptionally free-machining alloy of uniform composition and accurate dimension.

There's maximum economy and maximum performance in Noranda *High Inner Quality* Free-Cutting Brass Rod. Proper control of the amount of lead in this alloy gives fine chips that won't clog tools. Spindle-speed and feed-rate can go up, raising production. Tool wear will come down, cutting costs. Highest product quality is assured.

Noranda makes standard and special screw-machine alloys for practically every requirement. Call on our Technical Service Staff for assistance with your metal production planning. Look to Noranda *High I.Q.* alloys for more profitable production.

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Why you can cut costs with conveyor belts made with DU PONT NEOPRENE

Conveyor belts or any other rubber product made with Du Pont neoprene can be counted upon to give long, trouble-free service. For example: a conveyor belt of neoprene is still on the job after eight years of rugged duty in a coal mine. Neoprene's resistance to abrasion, oil, grease, chemicals and heat is your assurance of lower maintenance and replacement costs . . . so be sure to ask for NEOPRENE when you buy.

• New ways in which neoprene-made products effect savings for you are contained in every issue of the Elastomers Notebook. New and unusual applications are clearly shown. Get on the mailing list.

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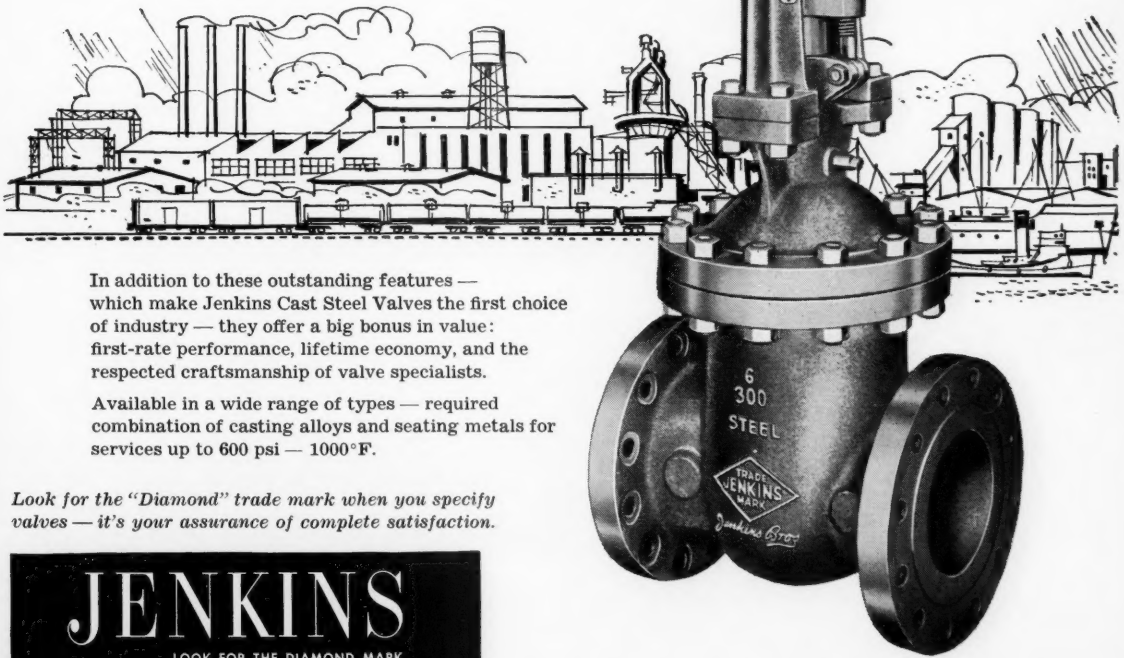
There's built-in extra value in JENKINS CAST STEEL VALVES

Jenkins Cast Steel Valves contain many design features developed by Jenkins Valve specialists, such as ball-bearing yoke sleeve, rust-proof packing, lantern-gland stuffing box, steel ring gasket and through-port gate, which make them unequalled in withstanding the rugged requirements of higher-pressure, higher-temperature services. Made of the highest-grade steel alloys, Jenkins Cast Steel Valves feature seating materials specially hardened to improve corrosion resistance and prevent erosion, seizing and galling.

For the heart of industry
JENKINS VALVES



In addition to these outstanding features — which make Jenkins Cast Steel Valves the first choice of industry — they offer a big bonus in value: first-rate performance, lifetime economy, and the respected craftsmanship of valve specialists.

Available in a wide range of types — required combination of casting alloys and seating metals for services up to 600 psi — 1000°F.

Look for the "Diamond" trade mark when you specify valves — it's your assurance of complete satisfaction.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
TRADE JENKINS MARK
Jenkins Bros.

Sold through leading industrial distributors

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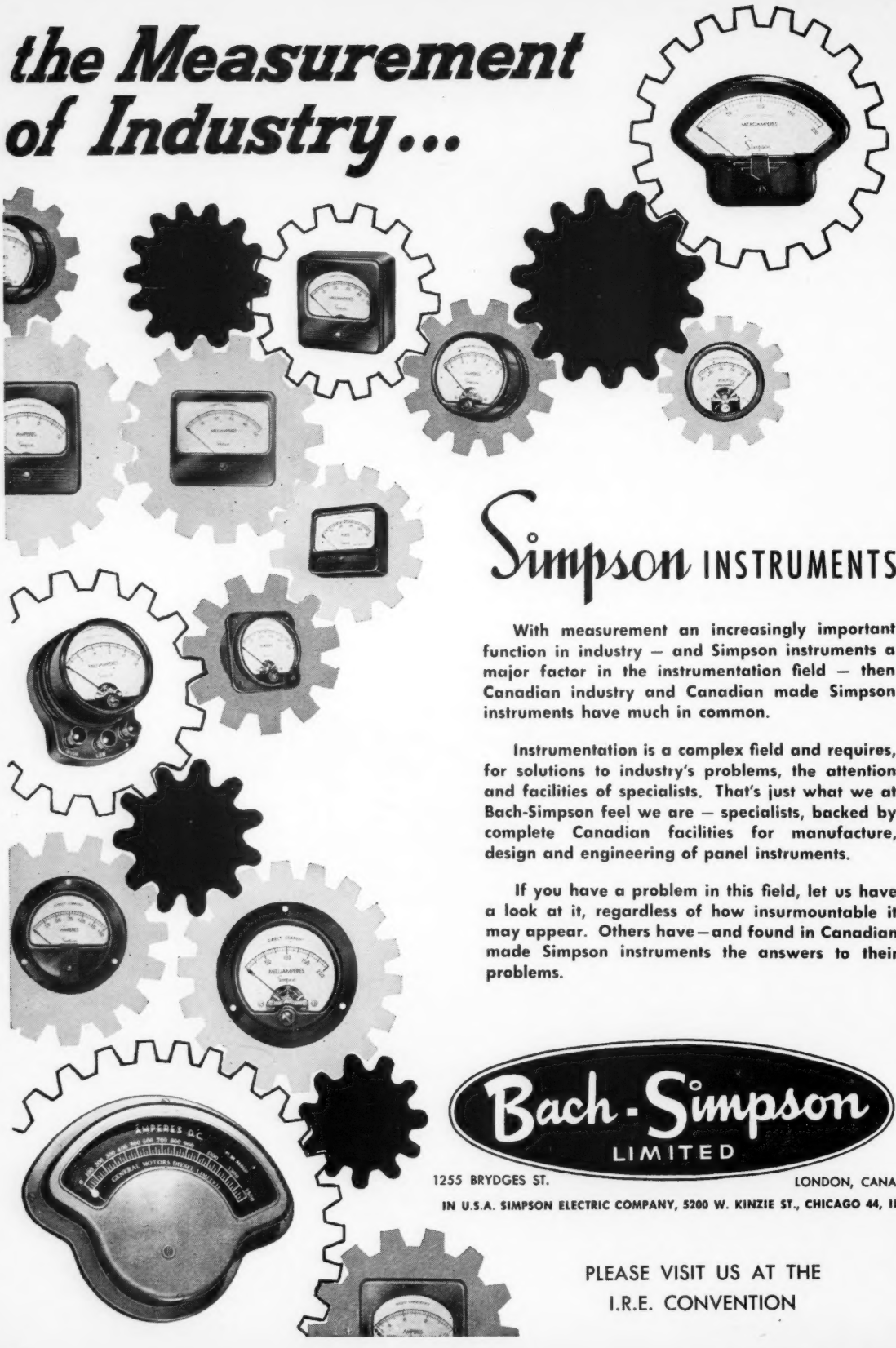
the Measurement of Industry...



Simpson INSTRUMENTS

With measurement an increasingly important function in industry — and Simpson instruments a major factor in the instrumentation field — then Canadian industry and Canadian made Simpson instruments have much in common.

Instrumentation is a complex field and requires, for solutions to industry's problems, the attention and facilities of specialists. That's just what we at Bach-Simpson feel we are — specialists, backed by complete Canadian facilities for manufacture, design and engineering of panel instruments.

If you have a problem in this field, let us have a look at it, regardless of how insurmountable it may appear. Others have—and found in Canadian made Simpson instruments the answers to their problems.

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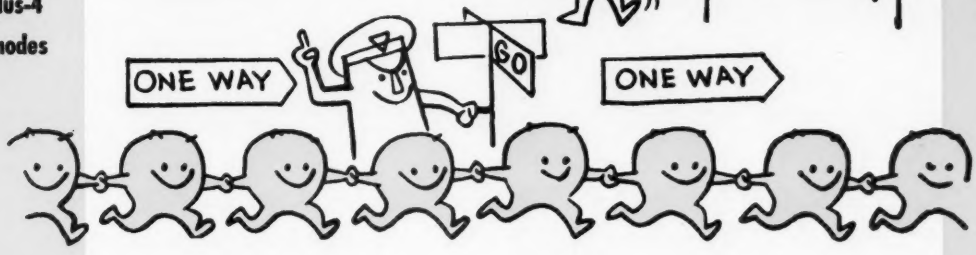
PLEASE VISIT US AT THE
I.R.E. CONVENTION

Anaconda Plus-4 Anodes

Phosphorus policemen arrest delinquent copper ions that want to play instead of work in the solution—thus preventing COPPER BUILD-UP and cutting cost of correcting solution.

Phosphorus policemen wake up lazy copper ions that want to settle down as SLUDGE in the bottom of the tank—thus making "bagging" and diaphragms unnecessary.

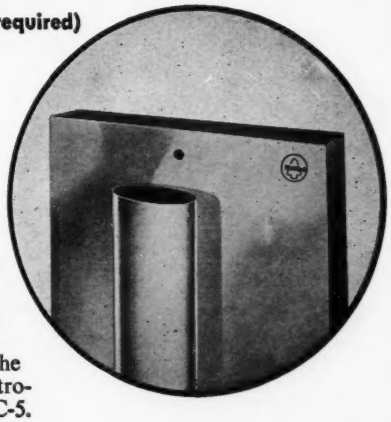
Your Work



Phosphorus traffic police keep copper moving uniformly to give you SMOOTH, HEAVY CATHODE DEPOSIT—up to 15% more cathode deposit per anode—and UNIFORM ANODE CORROSION leaving small "fish" that cut scrap losses.

PLATING COSTS LESS WITH ANACONDA "PLUS-4" ANODES

+1 no anode sludge (no "bagging" or diaphragms required)
+2 no copper "build-up" in solution
+3 smooth, heavy cathode deposits
+4 up to 15% more cathode deposit per anode



The playful characters above give perhaps an oversimplified explanation of a laboratory development now saving acid-copper electroplaters, electrotypers and electroformers a lot of time and money.

Metallurgists have found that if copper used as anodes contains a small but precisely controlled percentage of phosphorus, all the copper moves uniformly through the acid-copper solution to the object being plated. The phosphorus seems to act like a policeman.

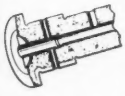
Anaconda "Plus-4" Phosphorized Copper Anodes are the result. They have been proving their superiority in acid electroplating tanks in many parts of Canada. Write for publication C-5.

ANACONDA

ANACONDA AMERICAN BRASS LIMITED
New Toronto, Ontario.
Sales Offices: Montreal and Vancouver

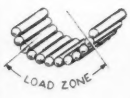
Performance features of **TORRINGTON CAM FOLLOWERS**

Heavy sectioned outer race to absorb high rolling and shock loads.

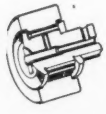


Integral stud for cantilever mounting, case-hardened, with tough core for high strength to withstand shock loads.

Easily relubricated at either end or through cross hole in stud. Ends accommodate standard drive grease fittings or plug seals.



Full complement of small diameter rollers for maximum radial capacity and efficient anti-friction performance.



Races precision ground for even load distribution and uniform low end play.

Built to "FOLLOW THROUGH" under high shock loads

Every feature of the Torrington Cam Follower is designed to insure efficient performance and long service life under heavy rolling and shock loads in cam or track follower service.

Precision made throughout, Torrington Cam Followers are available in sizes from ½" to 2¼" OD. Special surface finishes such as chrome and cadmium plate or oxide black can be provided.

Our engineering staff will be glad to work with you in applying these reliable units to your cam-controlled or track-type equipment. You can depend on Torrington Cam Followers to "follow through" on the job because every element is designed for ultimate capacity. *The Torrington Company Limited,* 925 Millwood Road, Toronto 17, Ont., Canada.

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completely protected at low cost with Polyethylene film

Transparent plastic film made of "Bakelite" polyethylene has successfully eliminated the need for vast storage sheds at Toronto Brick Company's Don Valley plant. Rain, snow and the effects of frost are sealed out, and bricks stay clean for best results in construction work. Lightweight and handy, the film can be drawn over brickpiles in a matter of minutes.

Whether you're packaging bricks, baby clothes, vegetables, candy, tobacco, etc., you'll package them better with polyethylene film. Consult your Bakelite technical representative to find out how this versatile plastic film can serve you.

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A chief supplier of Plastic Raw Materials to Industry
Division of UCC Union Carbide Canada Limited
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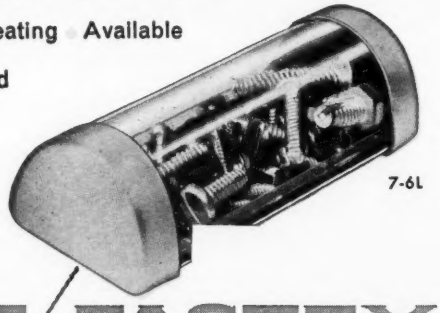
Special points, special heads, and special-purpose screws incorporating the Shakeproof Thread-Cutting slot provide added cost-cutting advantages.

End separate tapping costs • Shakeproof Thread-Cutting Screws cut perfectly mated threads • Available in three styles for metals, die-castings and plastics • Can be removed and re-used • Extra strength due to heat treating • Available in all standard head styles, pre-assembled as Sems, and in many special application designs as shown above.



7-61

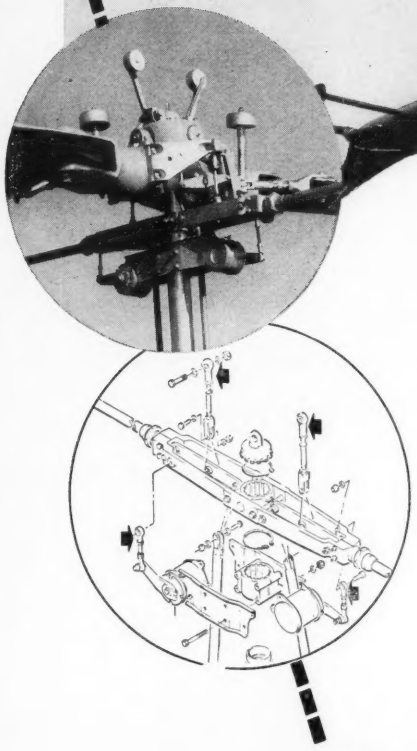
Write for sample kit containing Shakeproof Thread-Cutting Screw assortment

SHAKEPROOF / FASTEX

"FASTENING HEADQUARTERS"

DIVISION OF CANADA ILLINOIS TOOLS LTD.

67 SCARSDALE ROAD • DON MILLS, ONTARIO



THE NEW "BELL RANGER" HELICOPTER USES HEIM UNIBAL ROD ENDS

Model 47-J is the latest helicopter to be introduced to the commercial market by Bell Helicopter Corp., and has been named the Bell Ranger. It is a four-place, executive type machine with a deluxe interior or a series of quick-change cabin arrangements for cargo, litter, and internal hoist configurations.

HEIM Unibal Rod Ends were chosen for the linkages in the carburetor heat and mixture control installations, and in the main rotor stabilizer bar assembly. The rods link hydraulic dampers to the bar, which provides exceptional stability to the flight characteristics of Bell helicopters, acting like a gyroscope and, through mixing levers, keeps the rotor plane of rotation in its pre-established flight path.

THE HEIM *Unibal* is the spherical bearing which corrects misalignment in every direction because of the universal movement of the ball — Reduces friction and lost motion in linkages — Eliminates the effects of vibration — Lowers assembly costs because of its quick and easy installation — Carries heavier loads.

Perhaps Heim can help solve — or simplify — your linkage problems. Feel free to write. Be sure each engineering and purchasing department has a Heim catalog.

R&M BEARINGS CANADA LTD.

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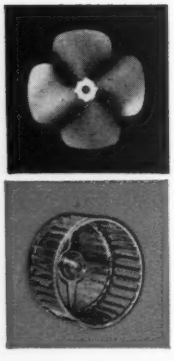
NEW & NEW & EQUAL NEWS



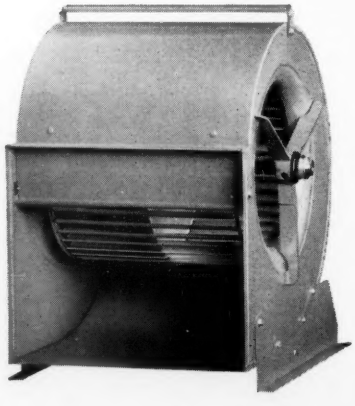
It's the *new* Torrington line of Vari-Basic blower units for central heating and air conditioning equipment, now in production at all three Torrington plants. And here is why this important product development is *news.*

1. New quality: Engineering features include the famous Center-Lock Airotor wheel design . . . permanently plastic lubricated Randall bearings, with 3-point suspension . . . and spot-welded heavy steel construction, superbly finished.

2. New flexibility: The units are designed for interchangeability with existing standard equipment, and Torrington's marketing policy makes these components available singly or in combination.

3. New versatility: These units are available in a wide range of sizes designed to provide maximum variability to meet directional-flow requirements.

Your inquiries are invited. For full information, *talk to Torrington!*



THE TORRINGTON MANUFACTURING COMPANY
OF CANADA LIMITED
OAKVILLE, ONTARIO • TORRINGTON, CONNECTICUT • VAN NUYS; CALIFORNIA

People

Important people who are in the news

Engineering Institute

At the conclusion of the 71st annual meeting of the Engineering Institute of Canada at Banff Springs Hotel, **Clement Matthew Anson** of Sydney, N.S. succeeded Vernon A. McKillop of London, Ontario, as president. Mr. Anson is vice-president and general manager of Dominion Iron & Steel Ltd.; James Pender & Co. Ltd.; and Dominion Shipping Co. Ltd.

Orenda

The appointments of **Sydney L. Britton** to the post of Chief Administrative Engineer and of **A. Edwin Caswell** to succeed him as Chief Projects Engineer have been announced by Orenda Engines Ltd.

Du Pont

Three appointments to positions of supervising engineer in its engineering department in Montreal have been announced by Du Pont of Canada. These appointments are: **R. N. Boyd** to be supervising engineer of design services, succeeding the late B. A. Evans; **J. O. Gage** to succeed Mr. Boyd of supervising engineer of design for explosives and film projects; **H. A. Mullins** to succeed Mr. Gage as supervising engineer of construction. Mr. Mullins has been purchasing agent for equipment in the purchasing and traffic department; he is succeeded by T. F. Scott, who was assistant purchasing agent for equipment.

Westinghouse

The appointment of **G. P. Adamson** as engineering manager for the Canadian Westinghouse Co.'s Electronic Division has been announced. He was formerly manager of Electronic Defense Contracts and will now be responsible for all divisional engineering and research facilities.

Atlas Steels

Mr. B. M. Hamilton has been appointed Chief Metallurgical Engineer and **Dr. R. Clark,** Manager of Laboratories and Research for Atlas Steels Ltd. Mr. Hamilton will direct the company's metallurgical service, process metallurgy and market development functions. Dr. Clark is now responsible for all laboratory-controlled functions as well as research, product and process development projects.

Linde

The appointment of **M. D. E. Robinson, P.Eng.,** as Assistant Manager, Engineering, Linde Air Products Co., has been announced. Prior to his present appointment he was Manager, Engineering Service, Western District.

Dominion Structural

Dominion Structural Steel Ltd., one of the Canada Iron Group, announces the appointment of **Mr. D. D. Currie, B.A.Sc., P.Eng.,** as sales manager of the company's Crane division. Prior to joining Dominion Structural, Mr. Currie was with Alcan.

Liquid Air

Russell A. Dunn has been appointed vice-president in charge of sales for Canadian Liquid Air Co. Ltd. Mr. Dunn, who is a metallurgist, has been with the company since 1939.

Stelco

The American Iron & Steel Institute Medal was awarded May 22 to **A. F. Mohri,** Chief Metallurgist, The Steel Co. of Canada, at the 65th general meeting of the Institute in New York. He received the award from Benjamin F. Fairless, president of the Institute.

Mr. Mohri won the medal for the excellence of his paper, "Metallurgical Aspects in the Design and Operation of a New Continuous Annealing Line."

CGE

Department heads of Electrical and Mechanical Engineering Faculties at thirteen Canadian universities recently met in Peterborough at an engineering professors conference arranged by CGE. The professors were invited to the conference in order that they might gain an appreciation of quality of engineering being carried on in the Canadian electrical industry. Events on the conference program included an engineering symposium in which recent developments in motors and generators, switch gear and industry control, power transformers, electronic equipment and general applied research were discussed. Among the 23 professors attending the conference were representatives of the University of Ottawa and the University of Western Ontario which will graduate electrical and mechanical engineers courses for the first time next year.

ADAMSON

MASON

Westinghouse

V. V. Mason has been appointed manager of the Canadian Westinghouse Atomic Energy Division at Hamilton, following the resignation of John D. Houlding. He was formerly engineering manager for the Atomic Energy Division.

Alloy Metal Sales

A. Harry Galley has been elected president of Alloy Metal Sales, succeeding Mr. Near in this position. Mr. Galley was the first sales manager of Alloy Metal Sales Ltd. and was elected vice-president in January 1943 and a director in March 1947.

RETMA

On June 21, Canadian Electronic Manufacturers elected **W. H. Jeffery** as president of the Radio Electronics Television Manufacturers Association of Canada at their 28th Annual Meeting. Mr. Jeffery is vice-president and general manager of Philco Corp. and has been in the Canadian electronics industry for nearly 30 years.

ANSON

BOYD

CLARK

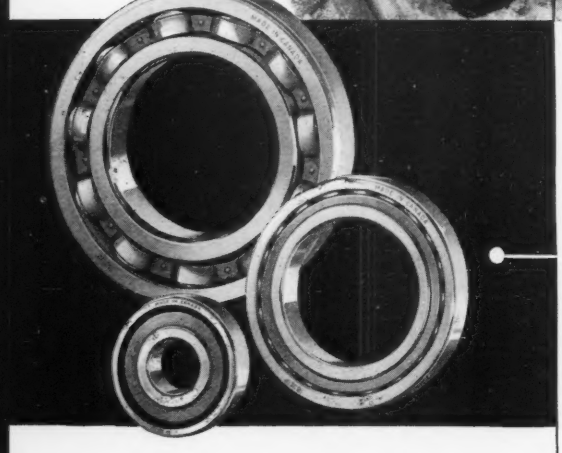
GAGE

HAMILTON

MULLINS

ROBINSON

*Pressurized helmet worn by pilots at high altitudes



SKF

THE FINEST BEARINGS IN THE WORL

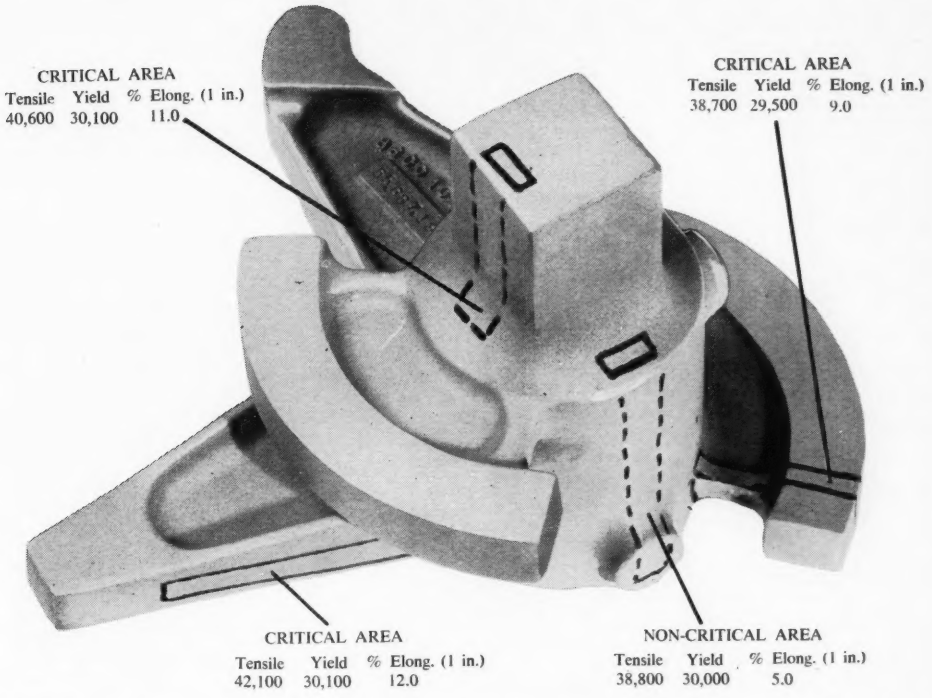
Salute to the Aircraft Industry

50th Anniversary

WORLD ORGANIZAT

CANADIAN SKF COMPANY
LIMITED

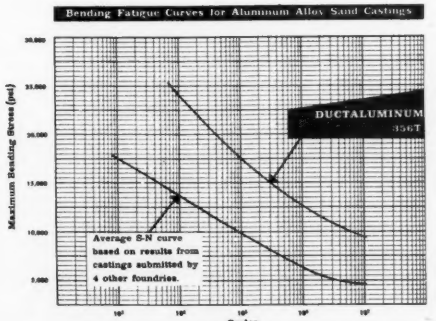
HEAD OFFICE AND MANUFACTURING DIVISION, 2201 EGLINTON AVENUE EAST, SCARBORO, ONTARIO
DISTRICT OFFICES COAST TO COAST



Even in non-critical areas, no part of a casting has less than 33,000 psi tensile, 27,000 psi yield.

Aluminum castings that are stronger

Modern aircraft need castings light and strong. These fill the bill


Bending Fatigue Curves for Aluminum Alloy Sand Castings
Maximum Bending Stress (psi)
DUCTALUMINUM
356T
Average S-N curve based on results from castings submitted by 4 other foundries.
Cycles

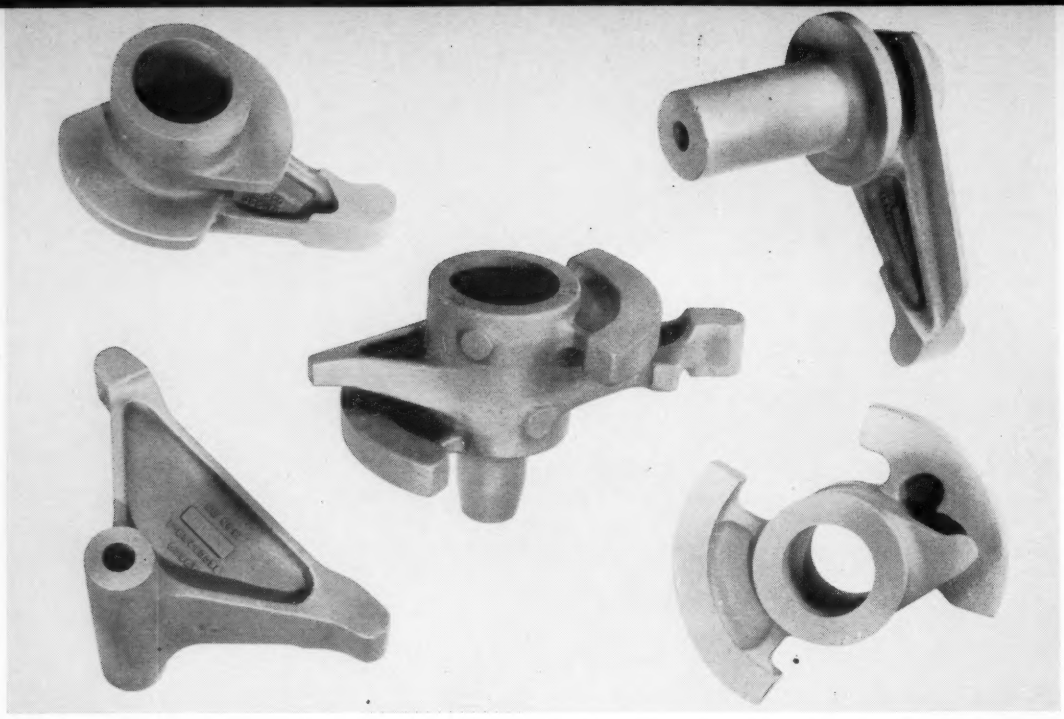
Ductaluminum is compared to other alloys.

Ductaluminum 356 castings (manufactured by American Brake Shoe Company) provide the higher strength desired by the aircraft industry for structural members and control assemblies. They are produced in two strength levels (356T and 356S) with guaranteed minimum mechanical properties in critical areas of the actual castings specified by the designer.

Even in non-critical areas, no part of a casting has less than 33,000 psi tensile, 27,000 psi yield and 3% elongation (36,000 psi, 32,000 psi and 2% elongation for the higher strength grade).

These strength levels are far above those required by Federal Specification QQ-A-601 a (see table of physical properties). Comparison of static test results by one airframe builder between Ductaluminum 356T and commercial 356-T6 castings of identical shape showed the former to be on the average 63% stronger.

Production of castings with these high levels of strength in every casting in each lot is a major advance



High mechanical properties of Ductaluminum castings result from exceptionally close metallurgical control.

beyond accepted industrial practice. The aircraft structures engineer may now obtain high strength aluminum castings with the knowledge that anticipated mechanical properties will be achieved in every part he receives.

The dependably high mechanical properties of Ductaluminum 356 castings are the result of exceptionally close metallurgical control, special melting and foundry techniques, and a rigorous inspection program. Better methods of casting aluminum have been developed from Brake Shoe's intensive research into the production of high strength aluminum castings for aircraft.

The castings are produced to the basic analysis for aluminum alloy 356-T6. To achieve the desired mechanical properties, alloying elements have been confined to a narrower range than that required by commercial or military specifications. Careful control of alloy ingredients and alloy balance has given a more complete control of the metallurgical structure.

Many of the causes of low mechanical properties in aluminum castings have been eliminated through improved control of the casting process. Stringent control of degassing ensures the effectiveness of this operation.

Guaranteed Analysis (QQ-A-601a-3)

Mg	Si	Cu	Fe	Mn	Zn	Ti	Al
0.20 to 0.40	6.5 to 7.5	0.20 max	0.50 max	0.30 max	0.30 max	0.20 max	Remainder

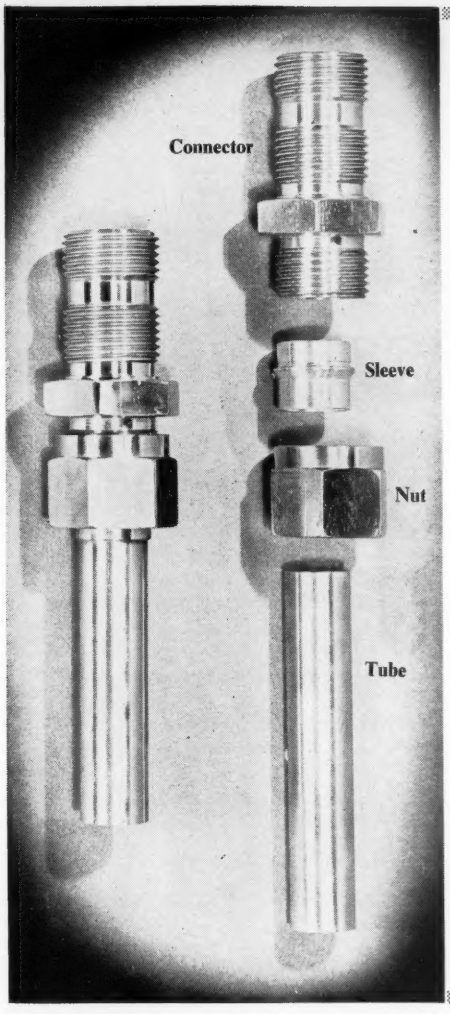
Guaranteed minimum mechanical properties:
(For sections 1 in. or under and for castings under 30 lb)

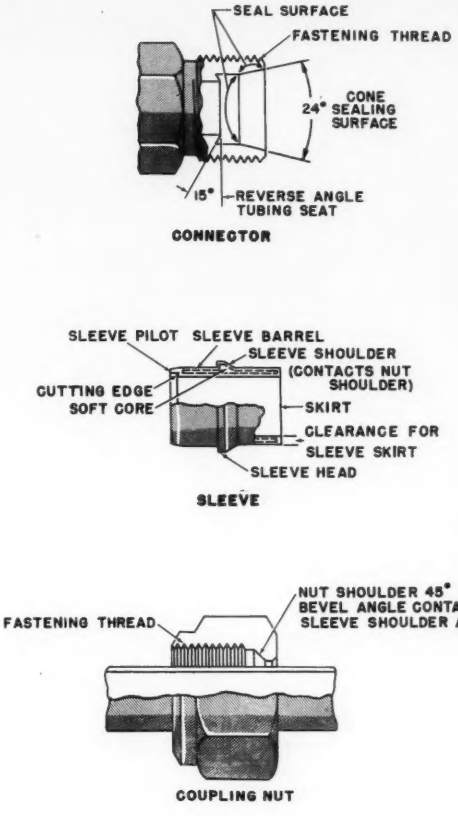
		UTS	YS	(Elongation (on 2 in.)
Ductaluminum 356T	Designated high stress areas in castings	38,000	28,000	6.0
	Minimum in any other area in castings	33,000	27,000	3.0
Ductaluminum 356S	Designated high stress areas in castings	42,000	35,000	3.0
	Minimum in any other area in castings	36,000	32,000	2.0
QQ-A-601-3	Separately cast test bars	30,000	20,000	3.0
	From castings — average	22,500	15,000	0.75

Typical mechanical properties:		UTS	YS	(Elongation (on 2 in.)
Ductaluminum 356T	In castings	40,000	30,000	8.0
Ductaluminum 356S	In castings	44,000	37,000	5.0
Industry typical	Sand, in test bars	33,000	24,000	4.0
	Permanent mold, in test bars	40,000	27,000	5.0

Specifications:

AMS	SAE	FEDERAL	NAVY	ASTM	A.F.-NAVY AIR
4217A	323	QQ-A-601-3	46Alf-3	B 26-55T	AN-A-39





1. Exploded view of MS flareless tube fitting shows great simplicity of these precision fluid couplings.

Fluid couplings are tougher than ever

Extremes in pressure, temperature and vibration face their designers

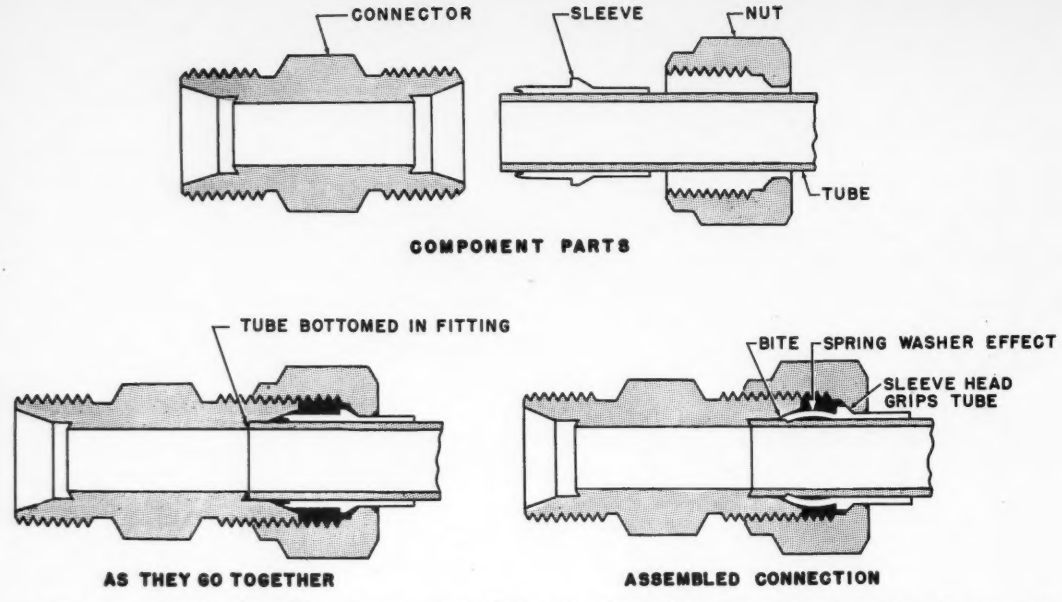
The principles still apply

Although the flareless fittings discussed here are primarily for aircraft, the basic design criteria and engineering recommendations will help the machine designer to find a practical use and application for them in future hydraulic circuits.

By Todd McCartney PARKER AIRCRAFT CO.

Coupling of hydraulic circuits and components has reached a point where it is no longer possible to select or specify hydraulic fittings as common pieces of hardware. Demands of extreme operating conditions (which today are becoming standard requirements) have necessitated the development of a precision fitting that can be adapted to these extremes at a reasonable cost from the standpoint of field use, maintenance and replacement as well as initial cost.

These extreme requirements (high temperature, high pressure and severe vibration) are now a reality to the



2. Parts are aligned, the tubing bottoms and, finally, the sleeve is bowed and seals against the connector.

The weight-saving properties of these new flareless fittings are two-fold

Fluid couplings continued

hydraulic circuit designer. Where a few short years ago, maximums of pressure and temperature were around 1,500 psi and 165 F, designers must now think in terms of 3,000 psi and 275 F. Furthermore, extensive development work is presently under way to bring these values up to 5,000 psi and 400 or 600 plus F, and perhaps still higher.

It has long been evident that the old AN flared hydraulic fitting would eventually have to be replaced, since it was originally designed when hydraulic circuit coupling demands were relatively low. Of all the possible replacements tested, the MS flareless fitting presents to the designer the best qualities, in answer not only to today's requirements, but also to the demands of the foreseeable future. The flareless fitting has been fully developed and experimentally tested over a period of time and has just recently been used on production basis quantities on some of the latest and most modern aircraft (such as the Lockheed F-104). Production use of this fitting has been so successful that some users claim they have never had such "leak-proof" fluid control systems.

MS flareless fittings consist of three basic parts: the connector, the nut and the sleeve (fig. 1). Combining resilient properties with a hardened cutting edge, the steel sleeve is the most critical fitting part. In order to obtain an effective seal, the sleeve must be machined and heat-treated within close tolerances. When the flareless fitting is assembled, the nut forces the sleeve pilot against the internal cone surface of the connector (fig. 2). As the nut advances, the cutting edge is pressed inward, "biting" into the tube to provide a firm grip. At the same time, the difference between the sleeve head angle and the nut angle compresses the head portion of the sleeve against the tube. With a compression force at the bite point of the sleeve, tightening of the nut swells or bows the sleeve outward. This does two things: the bowed portion of the sleeve contacts the cone surface to form the actual seal line; the resilient property of the sleeve makes it act as a spring-washer to keep the nut and tube tight during severe vibration or pressure pulsations. In order to have the hard cutting edge and the resilience necessary, the steel sleeve is case-hardened to a depth of 0.0015 to 0.0019 in. for hard surfaces with the soft ductile core.

In assembly of the flareless fitting, as the sleeve moves into the internal cone of the connector, the line of contact shortens and the unit pressure on it increases to produce a better seal. The AN-type flared fitting, on the other hand (though also having essentially a line seal), has three surfaces that must be controlled. These have a considerably longer and constant-length line of contact. These surfaces are the nose, block and flare, which must all be smooth, straight and concentric to obtain a good seal. In addition to other problems concerning flared fitting service life, these conditions are extremely difficult to control, giving rise to leakages during extended and severe operation.

In operation, the flareless fitting supports the tube at the point where the sleeve head grips the tube, at the bottoming point of the connector, and at the bite point.

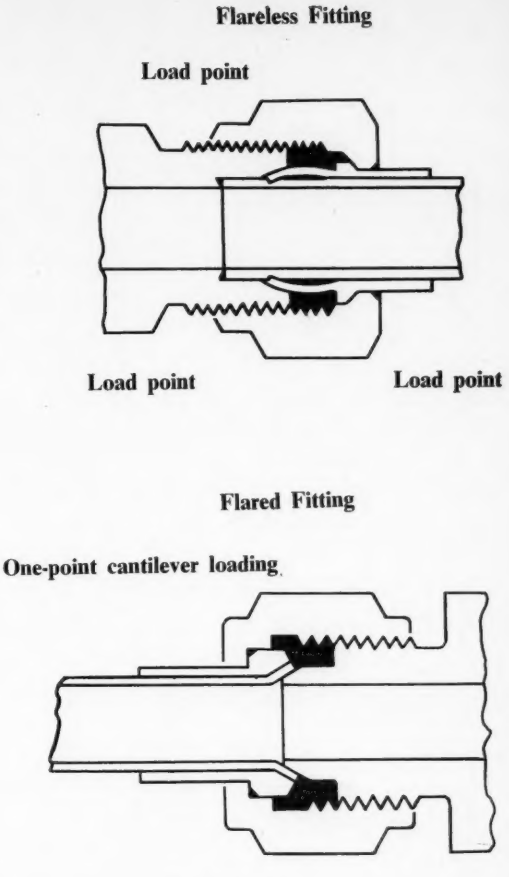
Three-point gripping resists vibration and pressure pulsation loads developed in continuously operating hydraulic systems. This additional support presents a considerable advantage over the flared-type fitting, which often fails at the base of the flare under severe vibrations because of one-point, cantilever loading (fig. 3). Vibration tests show the advantage of the three-point loading of the flareless fitting as opposed to the one-point loading of the flared fitting, the former having a life of from 5 to 10 times that of the latter.

In order to have the connector portion of the fitting completely interchangeable, Parker Aircraft Co. (through engineering co-ordination with airframe manufacturers) has pioneered in establishing strict controls to be maintained in manufacturing all three of the fitting parts, especially the sleeve and the connector. Connectors (such as adapters, unions, elbows and tees) all have external threads and an internal cone surface. A straight, counterbored section at the base of the cone guides the inserted tube until it reaches the seat.

Through the combined efforts of the users and manufacturers of the flareless fitting (they have worked closely together on the development of these fittings for production use) it was determined that the dimension from the bottoming point of the connector to the sealing point on the cone surface is the most critical dimension with respect to interchangeability. When this dimension is held within close tolerance, the connectors are completely interchangeable, a necessity from the standpoint of mass production.

There are two weight-saving advantages of the flareless fitting. Since there is no actual work performed on the tube (such as flaring), it is possible to specify the use of ½ to ¼ hard stainless steel tubing. This has a considerably higher strength-to-weight ratio than the aluminum alloys generally used. This stainless steel tubing can be used with flared type fittings, but it is usually necessary to heat-treat the end of the tube before it can be flared. This presents a definite problem with respect to field repairs, as well as complicating production application. An additional weight-saving feature of the flareless fitting over the flared fitting results from the fact that aluminum instead of steel connectors and nuts can be used. This is possible because a successful seal is not dependent upon these two parts compressing the tube between them, as is the case with flared-type fittings.

All MS flareless fittings parts (except the sleeve) can be fabricated from almost any material the designer cares to choose. For example, titanium fittings are available for high temperature application. Sleeves, however, are made only in steel (or stainless steel) to provide the required cutting edge and resilient properties. The method which the designer should use for formulating part numbers for MS flareless fittings is the same as that for AN flared tube fitting.



3. A comparison is drawn between the old flared type of fitting (below) and the newer flareless fitting.

Design recommendations

In the actual circuit layout design, the tube centreline should always be in line with the centreline of the connector and should be aligned in such a way that the tube will not have to be forced into position during assembly. If the tube configuration is misaligned, it becomes prestressed after installation, and may leak or fail completely during operation.

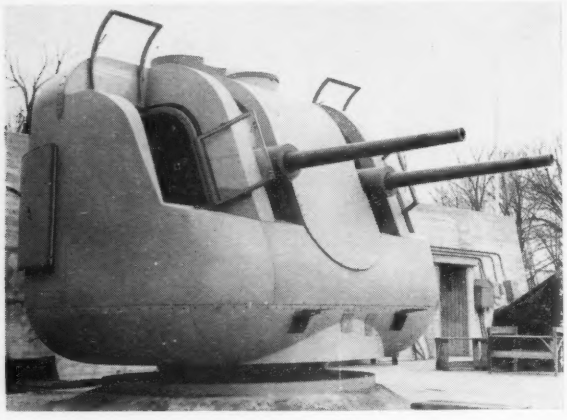
When specifying new precision parts (such as this MS flareless fitting) it is particularly important to include some necessary assembly requirements for correct use. The end of the tube (to which the fitting is to be applied) should be reasonably square and have no external scratches or dents near it. Any external distortion or cuts near the end of the tube may result in leakage by the sleeve. All burrs and sharp edges are to be removed from the inside and outside of the tube end, though there should be no appreciable chamfer.

Another important point for designers to note is that they should make clear to the assembly department what type of medium will pass through the tubes. This is necessary to keep the system clear of impurities, and in the case of oxygen, avoid the hazard of possible explosion during operation.

A group of reducer tube fittings (specified with the prefix ER rather than MS) is also available to the engineer, designed specifically to assist him in simplifying and reducing the number of potential circuit "leak-points." These fittings can be used wherever changes in tube size are necessary or desirable. Reducer fittings are available for specification in all sizes of ten different shapes.

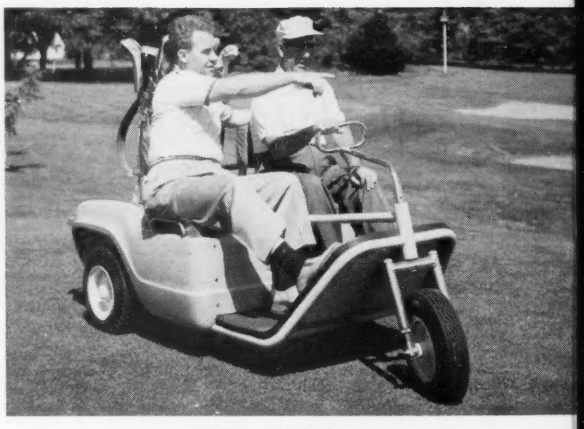
So successful has the MS flareless fitting been in production use that the U. S. military services have adopted it as standard on all future aircraft. Likewise, most of the commercial airlines (just a few months ago) endorsed the use of MS flareless fittings on all aircraft.

Design news in pictures



Plastics at war

When our Editor visited the Society of the Plastics Industry at their 15th Annual Convention and Exhibit in Ottawa in April this photo caught his attention. It shows a 3.5 in. twin naval gun which makes use of plastics industry products in its weathershield. (200)

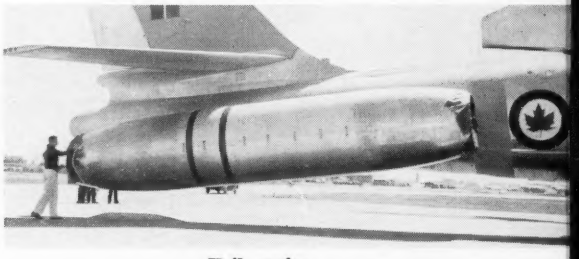


Follow that ball!

Time was when you played golf for the exercise that the walking gave (so you told your wife). With this "Diplomat" golf car you need kid yourself no longer. Electric motor whirring you should lick any footsore fool to your true goal — that nineteenth hole. (201)

Eight in the hand

Pride and joy of the CNR is their double-decked auto transporter. The car is the largest freight unit in service in North America and carries eight autos on its two decks. Loading and unloading under their own power, the automobiles run over special ramps. (202)



Tail engine

Orenda mounted their Iroquois pod in this odd place on the flying test-bed B-47 for several reasons. It eliminated damage from the engine tailcone, offered easier access for ground maintenance and allowed the engine almost undisturbed airflow at the intake. (203)

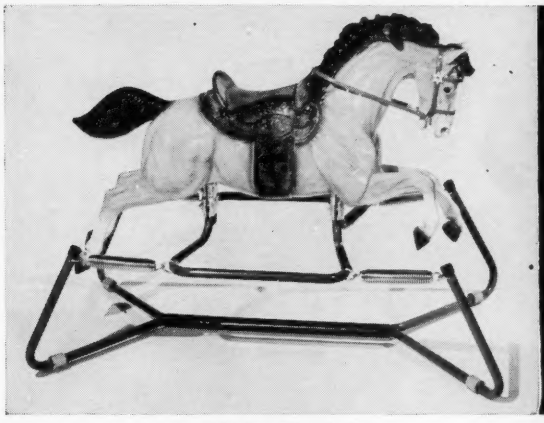
Perfect for pool

The surface plate at Orenda is flat to 7/10000 of an inch—all 72 sq. ft. of it. Made from a whopping slab of granite (12 x 6 x 2 ft.), it tips the scales at a hefty 15 tons and is being used to check large jigs, fixtures and test equipment on the new Iroquois. (204)

Insulating a reactor

To insulate a reactor shell the AEC used Foamglas, a non-fibrous, sealed, cellular glass structure. Studs were welded to the steel surface and 3 in. thick pads of Foamglas impaled on the studs after being buttered with mastic. Spring clips hold the blocks firm. (205)

Some modern designs making news today

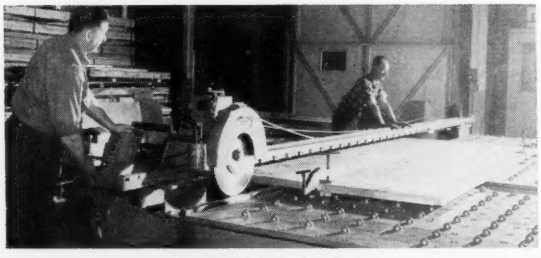


Yo-ho Silver!

Rocking-horse rodeo pundits have a new mount bucking them around the nursery. The pony, fitted out with a Mexican saddle, is one of the fanciest hollow rubber products ever moulded in one piece. A bucking motion is by steel springs. Piggy-bank bandits beware! (206)

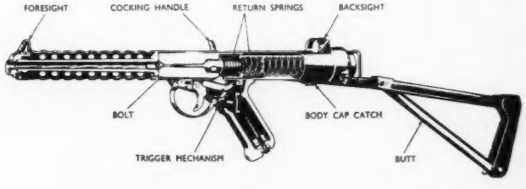
Mostest in the leastest

How's this for versatility? The unit shown "includes a baking . . . broiling oven combined, a warming oven, a refrigerator unit (5 cu. ft.), 3 sealed-type cooking elements and a stainless steel sink and faucets. The unit (which is only 4 ft. wide) is CSA approved. (207)



Appetite for aluminum

Slicing 2 in. aluminum slab is a piece of cake for the big saw designed for Avro. The saw cuts rough shapes into 3000 lb. slabs which are then fed to the big skin mill which eats out one-piece skins and stringers of only 300 lb. The saw handles slabs 5½ ft by 19 ft. (208)

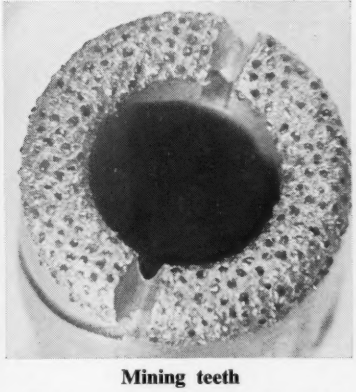


Stirling replaces Sten

The Stirling sub-machine-gun (formerly the Patchett) has been adopted by the Canadian Army to replace the Sten. This 9mm. automatic and single shot weapon is a simple gun which can be mastered fast. It weighs 6 lbs. and uses the same bayonet as the new FN rifles. (209)

Performance on tape

This performance recorder applies the automation principle to operational recordings on heavy plant and machine tools. Management has flow of relevant data. (210)



Mining teeth

With a set of teeth like this we'd have no difficulty with those nuts at Christmas. This is the business end of a diamond drill bit and has hundreds of stones set in it. (211)

Reactor model

This plastic model of the Belgian 11,500 kw. thermal reactor has been made by Westinghouse. Scaled down to one sixth, its 512 parts match those of real reactor. (212)

Clad metals conserve expensive alloys

These metals can also increase overall strength and speed-up welding

By John Woodward METALS & CONTROLS CORP.

Both ferrous and non-ferrous base metals can now be molecularly bonded (without brazing alloys or other intermediate agents) to practically any malleable metal.

These clad metals provide a new group of engineering materials, combining desirable engineering properties, many of which are not available in single metals. Clad ferrous metals can be used to conserve critical alloys; lower manufacturing cost; increase overall strength; and facilitate welding.

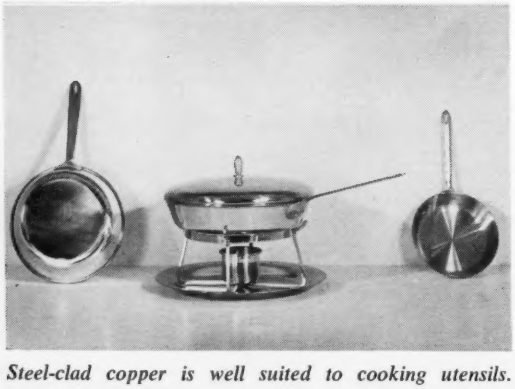
Clad metals consist of two (or more) single metals inseparably bonded (usually under heat and pressure) to provide a material with each layer of uniform thickness. Perhaps one of the most useful clad metal groups is the ferrous clad materials. Some of the ferrous clad metals commercially available today include:— Aluminum clad low carbon steel; aluminum—low carbon steel—nickel; nickel—low carbon steel—nickel; gilding metal clad steel; stainless clad copper; stainless clad low carbon steel; aluminum bearing alloy clad steel; copper clad hardenable carbon steel; other clad steel materials; brazing alloys clad on stainless.

Aluminum clad low carbon steel. Combines the surface characteristics of aluminum with the physical and mechanical properties of steel and frequently replaces other materials because of its well proved heat-reflective and heat-resistant properties, and its ability to resist corrosion at elevated temperatures. Heat exchanger tubes, liners and component parts for space heaters, water heaters, ranges, aircraft fire-walls and toaster inner parts are a few typical applications. The material is well suited for applications requiring an aluminum surface to resist atmospheric corrosion and a steel backing to provide sufficient strength to allow substantial reduction in the guage of material required.

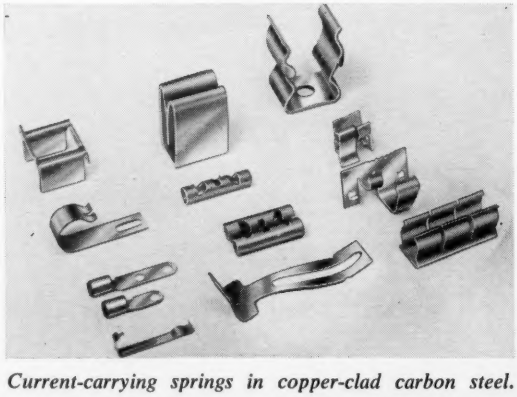
Aluminum clad low carbon steel strips are also used to replace pure nickel in many electron tubes. This material compares favourably with pure nickel for many electron tube parts; it is also cheaper. It is more economical than nickel and its lower density gives over 20% more parts per lb. Further cost reduction is obtained by eliminating the carbonizing operation required on some nickel parts. This clad material is supplied with a matte finish that provides maximum radiation properties after parts are "blackened" by firing. The radiation coefficient of the blackened material is about 85% that of a black body.

Aluminum—low carbon steel—nickel. For some electronic tube parts the requirements call for a thin nickel layer on one side of the material. This material is a low carbon steel with 10% cladding of aluminum on one side and 10% nickel on the other. Another electronic application is a small can, such as is used to en-

"The clad metals provide a new group of materials combining desirable



Steel-clad copper is well suited to cooking utensils.



Current-carrying springs in copper-clad carbon steel.

close transistors and other parts in electronic devices. The aluminum layer provides a corrosion-resistant surface; the nickel, a surface suitable for soft soldering.

Nickel—low carbon steel—nickel. Another ferrous base metal combination has a thin nickel layer on both sides. Primary uses for this material are found in the radio industry for tube parts, and by transistor manufacturers for nickel tabs.

Gilding metal clad steel. Clad steel bullet jackets have replaced solid gilding metal (90% copper, 10% zinc alloy) and solid cupro-nickel (80% copper, 20% nickel alloy) jackets, thus making available large tonnages of copper, zinc and critical nickel for other purposes. For this application, gilding metal is clad to both sides of a steel core. Several steel companies have produced this clad metal for small-arms ammunition. Present clad ingots of 2,000 to 3,000 lb. permit high yield of usable material in fabrication. Processes for separating the steel and copper alloy cladding permit salvage of steel and copper from the scrap.

Stainless clad copper. Stainless clad copper combines the high thermal conductivity of copper with the high temperature and corrosion resistance of stainless. The thermal conductivity of solid stainless is one of the poorest of all constructional metals, although the high temperature and corrosion-resistance properties are good. Stainless clad copper possesses a much higher thermal conductivity than solid stainless and eliminates the formation of hot spots at the point of heat concentration. Tests have shown that 25/50/25 thickness ratio of double-clad stainless on copper provides an apparent lateral conductivity higher than solid copper. This point is explained by the fact that the stainless cladding is a partial heat insulator. The heat is therefore unable to dissipate as rapidly as it does with solid copper. Cooking utensils, cooling plates, fins for space heaters and heat exchanger devices of various types are typical applications where stainless clad copper is desirable for uniform heat transfer. In other applications (such as jet engine or gas turbine components, exhaust manifolds and similar parts) the copper core is necessary to to increase lateral heat flow and prevent hot spot formations that might cause cracking or buckling.

Stainless clad low carbon steel. This is a low cost combination used in applications requiring the corrosion resistance of stainless steel. In cook ware, for example, the iron core is better and cheaper than solid stainless.

Aluminum bearing alloy clad steel. There are some bearing applications where an aluminum bearing alloy is desirable but its low strength has made it unsatisfactory. Automotive bearing applications (thrust washers, bushings and split bushings) are one such group. A new clad metal consisting of aluminum bearing alloy clad to a steel backing metal provides the required strength and fatigue resistance and yet maintains the aluminum alloy properties on the bearing surface.

Copper clad hardenable carbon steel. Copper clad to one (or both) sides of hardenable carbon steel is one of the latest composite metals put into production for spring applications. This material compares with beryllium copper in many respects, but with somewhat lower fatigue resistance. The main advantage is its lower cost.

The electrical conductivity of copper clad hardenable steel depends principally on the thickness of the copper-cladding. Ratios of thickness for the copper double clad on hardenable steel can be produced to offer higher electrical conductivity than beryllium copper when the same overall thickness of materials is compared. Also, the stiffness is higher for copper-clad hardenable steel than for beryllium copper. Typical applications are fuse clips, thin blade or spiral type springs and clips used for electrical connectors not subjected to frequent arcing. In other applications (such as pen and pencil clips) the thin layer of copper provides a good surface for decorative electroplated finishes. In these instances, the thickness of the copper cladding layer need only be as thick as 5% of the overall thickness of the material.

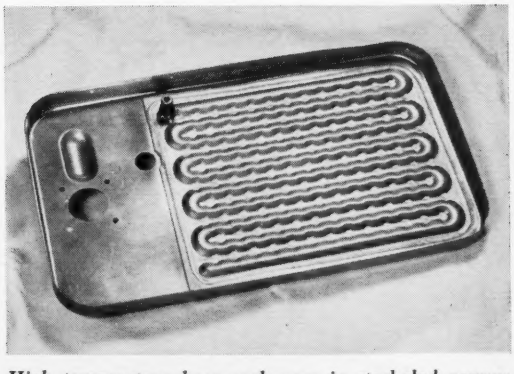
Further examples

Other clad metal materials. Zirconium, titanium, tantalum and other similar rare metals are characterized by excellent corrosion-resistance, a high melting point, light weight and other properties that make them preferable for specific applications. Their use has been limited, however, because of high cost and the difficulty of joining them. Some precious metals clad to steel are still in the development stage. Titanium clad steel, for example, has only been fabricated in small experimental amounts. A composite, consisting of the rare metal bonded to a common base metal, provides a material that preserves the surface qualities of the rare metal, lowers the over-all cost.

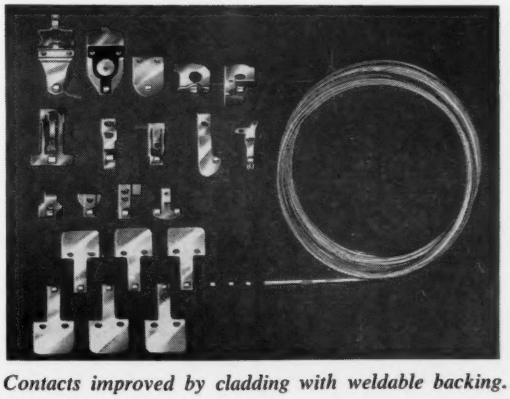
Platinum, gold, silver and their alloys clad to less

Continued on page 62

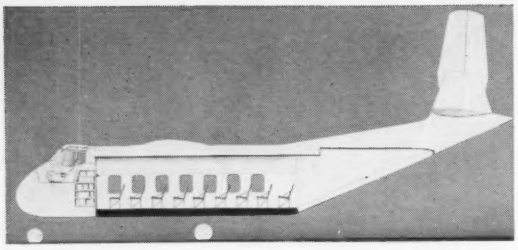
engineering properties — many of them can't be found in single metals"



High temperature heat exchanger in steel-clad copper.



Contacts improved by cladding with weldable backing.



In utility layout, Caribou has folding seats for 27.

This transport is really versatile

This aerial quick-change artist is Canadian designed and manufactured

The DHC Caribou twin-engined transport is the most recent development of de Havilland Aircraft of Canada Limited. Designed primarily to serve as an army aircraft for close military support in forward areas, it should also prove invaluable to civilian operators working out of limited areas. The short take-off and landing distances (characteristic of all their designs) is retained in the DHC-4, even though the load-carrying capacity may vary from 5,000 to 7,300 lb. The take-off and landing runs to clear a 50-ft obstacle in zero wind conditions will be approximately 700 ft. The range of the aircraft will be about 1,200 statute miles.

The 3-view layout spotlights a number of important features of this new light cargo transport.

Predominant is the high cockpit which affords clear, all-round unobstructed visibility for the crew. The upsweep to the tail section helps unloading and the high-set tailplane allows for the safe, fast air-drop of men or supplies.

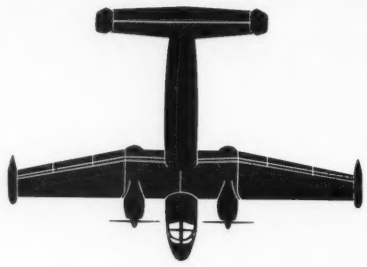
When used for vehicle transport the Caribou is designed to carry two jeeps. The swing-down ramp at the rear of the fuselage allows the cargo to be loaded and unloaded in the minimum space of time.

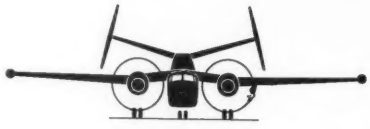
Motor transport or troops are ready to go into action as soon as the aircraft arrives at its destination.

A variety of internal configurations will be available in the Caribou for cargo or passengers. It will have accommodation for 27 passengers (and the crew). This will make it suitable for low ton-mile operating costs for airline or feeder line operations.

The structure is a conventional one, capable of absorbing a maximum of rough treatment with a minimum of field maintenance.

The aerodynamic features that give the aircraft its short field performance and low-speed handling qualities are a logical extension of those developed in the Beaver and the Otter. The high performance claim for the aircraft is therefore based on known quantities. ★





Performance (with Pratt & Whitney R-2000-D5)

Take-off rating at sea-level (static)	1450 bhp at 2700 rpm
Take-off static thrust	5800 lb.
Max. continuous power	1200 bhp at 2500 rpm

Other data

Wing area	912 sq. ft.
Span	95 ft.
Aspect ratio	10
Weight empty	14500 lb.
Design gross weight	24000 lb.

	Zero Wind	10 mph head wind
Take-off and landing (short field technique)		
Take-off ground run (ft)	450	330
Total take-off distance to clear 50-ft. obstacle (ft)	800	650
Landing ground run (dry concrete surface) (ft)	300	230
Total landing distance from 50-ft. obstacle (ft)	700	550

Cruising power 2 x 750 bhp (auto-lean mixture)
Cruising speed ..... 185 mph TAS at 7,500 ft.
Stalling Speed (flaps landing) .... 59 mph EAS

Payload-range (freighter)
For 200 statute miles, ... payload = 7320 lb
400 statute miles, ... payload = 6700 lb
600 statute miles, ... payload = 6000 lb

How are sleeve bearings designed for optimum performance?

The challenge of making sleeve bearings for modern engines is tough but manufacturers accept as routine problems once thought insoluble

HOW THE SLEEVE BEARING STARTED

Some 5,000 years ago, shortly after the invention of the wheel, the sleeve bearing came into existence. The first important bench mark was established in 1839 when Isaac Babbitt obtained a patent on a tin-base alloy, as a result of which his name has become the generic term for all "white metal" bearing alloys. Numerous assaults have been launched against Babbitt's original alloy, and yet today it stands as one of the finest materials available for many applications. However, as modern engines embarked on the never-ending spiral of higher hp and longer life (with less weight in less space), the requirements for satisfactory bearing performance have been continually increased.

The original concept of a bearing involved two factors: that of a low friction element plus a fuse or safety factor. It was obviously cheaper to replace a bearing than a crankshaft, and a bearing which failed would have been considered to have functioned well if it saved more expensive components from damage.

The bearing of today must withstand higher loads at increased intervals, higher operating temperature, must absorb more dirt and abrasive particles, must withstand the attack of corrosive acids and must absorb manufacturing tolerances by being able to conform to the shaft. It must also be of simple design, easy to install, capable of being mass-produced to rigid tolerances and still priced to sell. This challenge has been well met by the bearing manufacturers of today, who accept, as routine, problems that would have been considered impossible not too many years ago.

By T. J. Maloney CLEVITE LTD.

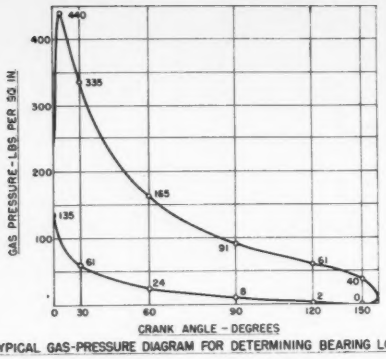
Early engines ran on cast-in-place, hand scraped main and connecting rod bearings, while most cam shafts operated directly in a cast iron housing. Some of the more expensive engines used babbitted bronze insert bearings for the camshaft, but such a design was too costly for most engines. However, steel backed babbitt bearings were centrifugally cast, the installation simplified and soon all camshafts were running in bearings.

The first insert crankshaft bearings in automotive engines were bronze backed babbitt, but it became evident that bearing failures were caused by fatigue of the bronze backs when heavy load conditions were encountered. It was natural to turn to the steel backed bearing material being used for camshafts and this proved to be the answer to the problem. Instead of centrifugally cast shells, a continuous strip casting process was developed, and the basis of current bearing technology was available. It was the task of the bearing engineer to reduce much of the art and mystery of the early days to theory and practice which would be satisfactory today.

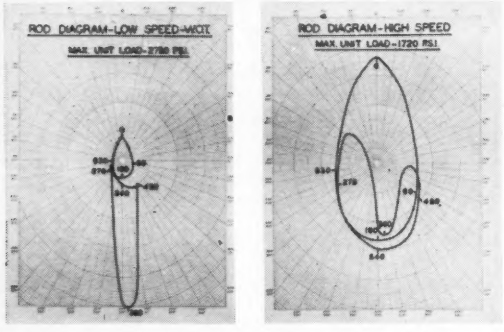
At one time, the selection of an appropriate PV factor was considered an adequate solution of a bearing problem. This was an attempt to apply the principles of dry friction power loss to oily surfaces in which there was partial metal to metal contact. The product of the unit pressure P and the rubbing velocity V was then a measure of the power loss, which was assumed to be proportional to wear. However, in a well-designed and properly operating bearing we know that metal to metal contact occurs only at the beginning (or end) of operation, and the performance cannot be predicted by such a simple relationship as $PV = K$.

In order to insure satisfactory bearings, the following steps should be covered by the designers and the manufacturers.

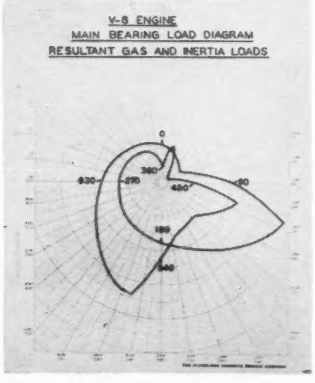
- Determine the bearing loads
- Determine the bearing material
- Make a lubrication study



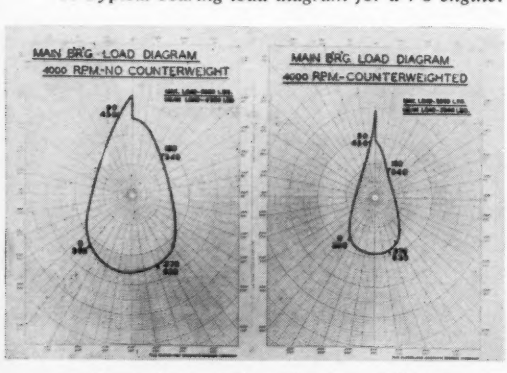
1. Gas loads can be determined from this diagram.



2a and 2b. Bearing loadings at low and high speed.



3. Typical bearing load diagram for a V8 engine.



4. Crankshaft unbalanced and partially balanced.

- Make sample bearings
- Study the bearing assembly
- Conduct dynamometer tests and evaluate results
- Study the results of field tests
- Modify the design if necessary

The first step in the design of bearings for a new engine involves the determination of the loads on the crank pin. These loads are the vector sum of the loads resulting from the combustion of gas in the cylinder, and the inertia forces developed by the rotating and oscillating members. The gas loads are determined from the familiar indicator diagram shown in fig 1, wherein gas pressure is plotted against piston displacement. The inertia forces vary with the speed of the engine, and are calculated from the weights of the reciprocating parts and the unbalanced rotating weights. The sum of all the forces is then plotted, as in fig 2. Since the magnitude of the inertia forces varies widely with speed, it is necessary to develop diagrams over a range of engine speeds. Fig 2(a) illustrates the rod bearing loading which occurs at full throttle and low speed, a condition encountered in trucks or tractors operating under a "lugging" condition. The maximum unit loading is 2,750 psi on the rod half of the bearing, and since engine speed is low, the oil supply is usually not adequate for proper cooling.

Fig 2(b) is drawn for the same engine operating at high speed. The inertia forces become dominant, and the shape of the diagram is entirely different from fig 2(a). The maximum loading is reduced to 1,720 psi. and its location moves to the cap half of the bearing. If this engine were limited to passenger car application (where high speed conditions exist most of the time) it would operate satisfactorily with micro-babbitt bearings. If the engine had to be used in trucks or tractors, it would be necessary to use heavy duty bearings to handle the 2,750 psi loading shown in fig 2(a).

Main bearings. With the rod bearing loads computed (and knowing the unbalanced weights on the crankshaft, the distance between bearings and the firing order), it is possible to calculate the main bearing loads. Fig 3 is typical of the main bearing diagrams in a V-8 engine.

HERE'S HOW THE BEARINGS PERFORM

Lead Babbitt. Excellent seizure resistance, deformability and ability to imbed. Fair resistance to corrosion and fatigue. Should not be used over 250F for best results.

Tin Babbitt. Excellent seizure resistance, deformability, imbeddability and corrosion resistance. Harder than lead babbitt at room temperature, but softens rapidly as temperature exceeds 250F.

Leaded Bronze. Excellent load carrying capacity, but poor surface behavior and corrosion resistance in comparison with the babbitts.

Aluminum Alloys. Excellent corrosion and fatigue resistance, but surface properties are inferior to babbitt. Has a tendency to seize on soft shafts. High coefficient of expansion adds to design problems.

Silver. Excellent corrosion and fatigue resistance but

The magnitude of the load determines the material to be used, and the direction of the load influences such factors as oil grooves, parting line chamfers, eccentricity and spreader grooves.

Since the inertia loads are greatest at high speed, engines designed for use in passenger cars operate at lower loads by using balanced crankshafts. The shaft should be counterbalanced as much as possible commensurate with stiffness, space limitations and economic aspects. The effect is demonstrated in fig 4, which shows a comparison of two engines under identical conditions. The diagram on the left is for the engine with an unbalanced crankshaft and the one on the right is for a partially balanced crankshaft. A 50% balance has resulted in a 12% reduction in the maximum bearing load and a 27% reduction in the mean load.

The shape of the diagram is as important as the maximum values obtained from it, as is demonstrated in fig 5. The problems caused by this bearing were the result of load location, rather than the degree of loading. There was a heavy load at the parting line, and shaft whip, deflection and thermal distortion were greater in this bearing than any other in the engine. All these factors must be considered if a bearing design is to be successful, for they influence such items as clearance, spreader grooves, chamfers and, of course, the rigidity of the bearing housing.

Bearing material. The bearing material is so related to load carrying capacity that when the loads have been determined the material may be considered to have been specified. Despite years of research, there is still no completely accepted theory as to why some materials operate as bearings while others do not.

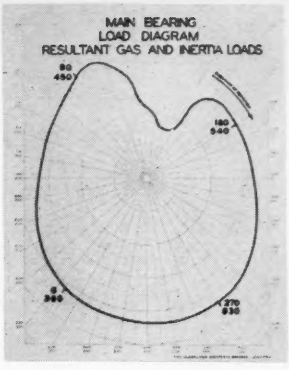
Essentially, the use of any material involves a compromise between the following properties which are known to contribute to good bearing performance.

(1) Seizure resistance.

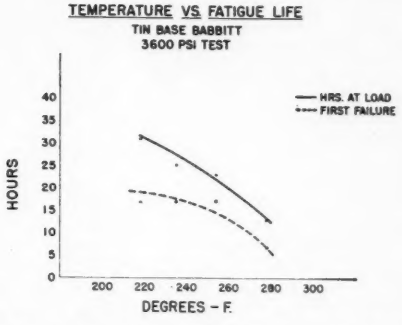
Although a bearing generally operates on an oil film, there is metal-to-metal contact at the start of operation (and at times during operation) and it is important that the tendency for the bearing metal to has surface properties inferior to babbitt. Expensive bearing metal and is generally restricted to aircraft engines. A lead-indium plated overlay may be used to improve surface properties.

Tri-metal bearing. A precision overlay of lead-tin-copper (either cast or plated on leaded bronze or aluminum) has resulted in a bearing with the surface properties of babbitt and the strength and fatigue resistance of the bronzes or aluminum. The construction results in a relatively expensive bearing, performing very well in heavy duty applications.

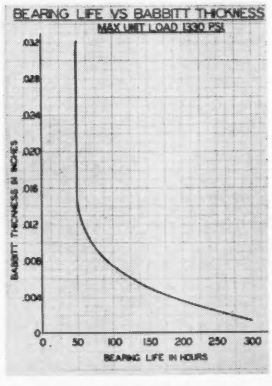
Moraine 100 (General Motors). This bearing has an intermediate layer of porous sintered copper-nickel impregnated and overlaid with babbit. Excellent surface properties. Essentially a reinforced thick babbitt with a safety factor for digesting discrepancies in alignment.



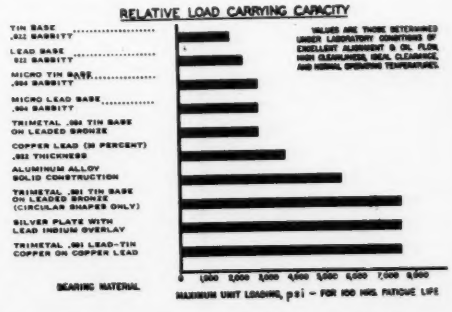
5. Result of heavy loading at the parting line.



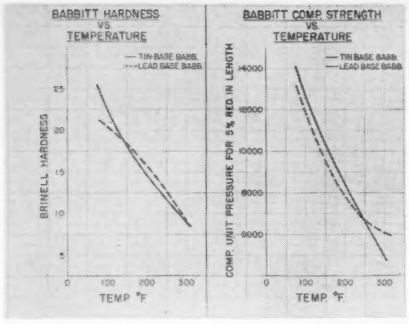
6. Decreasing fatigue life follows overloading.



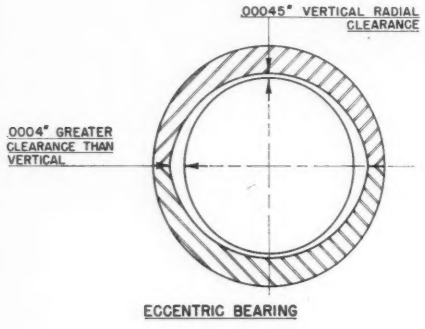
7. Effect of babbitt thickness on fatigue life.


RELATIVE LOAD CARRYING CAPACITY
TIN BASE .032 BABBITT
LEAD BASE .032 BABBITT
MICRO TIN BASE .004 BABBITT
MICRO LEAD BASE .004 BABBITT
TRIMETAL .004 TIN BASE ON LEADED BRONZE
COPPER LEAD (IN PERCENT) .002 THICKNESS
ALUMINUM ALLOY SOLID CONSTRUCTION
TRIMETAL .001 TIN BASE ON LEADED BRONZE (CIRCULAR SHAPED ONLY)
SILVER PLATE WITH LEAD INDIUM OVERLAY
TRIMETAL .001 LEAD-TIN COPPER ON COPPER LEAD
BEARING MATERIAL
VALUES ARE THOSE DETERMINED UNDER LABORATORY CONDITIONS OF EXCELLENT ALIGNMENT & OIL FILM, HIGH CLEANLINESS, IDEAL CLEARANCE, AND NORMAL OPERATING TEMPERATURES.
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
MAXIMUM UNIT LOADING, psi – FOR 100 HRS. FATIGUE LIFE

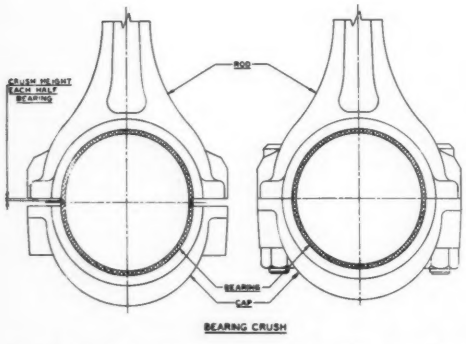
8. Some load carrying capacities in comparison.



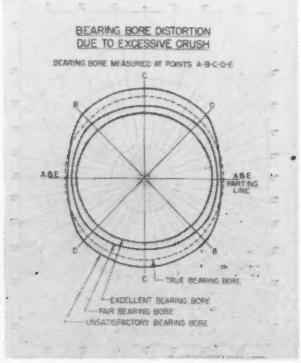
9 and 10. Heat reduces fatigue life and hardness.



11. This arrangement allows additional oilflow.



12. Each half bearing longer than its seat bore.



13. Crush effect on the bore of a connecting rod.

seize (or to transfer particles to the shaft) be a minimum.

(2) Low coefficient of friction.

Low coefficient of friction is necessary to keep wear and friction loss to a minimum. Such material usually conveys a feeling of oiliness to the touch.

(3) Low modulus of elasticity.

Shaft deflection and misalignment can best be assimilated by bearings which conform by plastic deformation. Also, dirt in the oil will either stay in the clearance space and score the shaft, or else be absorbed by displacing a like volume of bearing metal.

(4) Fatigue resistance.

Due to the nature of the bearing loads, a good material must withstand alternating stresses without premature failure in fatigue. Fatigue life is decreased rapidly when material is overloaded or operated at excessive temperatures, as is shown in fig 6. While most failures are ultimately fatigue, premature failures are usually induced by overloading or high operating temperatures or a combination of the two.

Other factors

(5) Corrosion resistance.

Deterioration of oils results in the formation of organic acids, and it is important for bearing metals to withstand the corrosive attack with a minimum of metal loss. Actual mechanical erosion may result from oil pressure, or in situations where there is fluctuation from high pressure to vacuum in a high impact type loading.

(6) High melting point.

Bearing metal should not soften appreciably at the operating temperature of the engine. It should be remembered that the actual temperature of the bearing face will be considerably higher than measurements taken on bearing backs or from the oil sump, since the face friction is the generating source of the heat.

Characteristics of bearing metals. For practical purposes we may consider that all modern bearing alloys are bonded to a steel back. The discovery that fatigue life increased as the babbitt thickness decreased has contributed more to the load carrying capacity of various alloys than any modification of alloy composition. It has also influenced the development of the trimetal type of construction. Fig 7 shows the effect of babbitt thickness on fatigue life. Properties of some of the more common bearing materials are given in the table, and the relative load carrying capacity of some of these materials in fig 8.

Excessive heat is always detrimental to a bearing, since it reduces the fatigue life, hardness and compressive strength (see figs 6, 9, and 10). A lube study must therefore be made to determine the conditions necessary to cool the bearing to the desired operating range. Knowing the bearing load, length and groove dimensions, the shaft size and speed, oil sump temperature, the grade of oil and the supply pressure, it is possible to find reasonable values of the following for various clearances.

- Effective viscosity
- Rate of oil flow
- Friction torque and accompanying power loss
- Oil film thickness
- Bearing temperature

Essentially the thicker oil film will result in lower bearing temperatures, and hence better performance from the bearings. Moreover, the larger clearances

Continued on page 64

Tolerance that's finer than a pencil line

Using silver solder instead of a pencil they can draw to 3/1000 in.

One of the problems arising from the fine tolerances required in modern jet engine manufacture is the specific problem of a group of Orenda draftsmen. It is their job to make the charts used for checking the tolerances on turbine and compressor blades. The measurements (and the degree of accuracy required) are finer than the naked eye can detect.

This will be understood when it is realized that a pencil draws a line about 6/1000 in. wide and yet tolerances of ± 3/1000 in. are required on a large drawing.

Working to such measurements requires specialists using an extremely accurate steel scale, in conjunction with a 10-power magnifying glass. Silver solder is used instead of pencil for some of the work because it holds line width better. A 40-power glass is used for checking the finished product.

The expansion and contraction of the materials can be ignored, even under these accuracy requirements.

There are many different blade shapes in an engine, and a chart is required for each. The shape also varies along the length of a blade. Curves are plotted at several different stations along the blade length and laid out 10 times full-size on a large sheet of aluminum, painted white and rubbed with glass paper to ensure smoothness. (Aluminum is used because it is light to handle, stable as to size under temperature changes and economical.)

The master chart is made by tracing the curves from the aluminum plate on to a vinyl sheet and superimposing them in their proper relationship to each other. (Vinyl is transparent, flexible, not easily broken, and has a low coefficient of expansion and contraction.)

On the other hand, vinyl shrinks slightly with age, so glass negatives are made from the vinyl sheets because this material is not so affected. The charts used in the shop are copied from the glass negative on to other vinyl sheets.

The procedure for making the blade root charts is slightly different, because the tolerances are much finer. The drawing is laid out 50 times full-size (instead of 10) and the thickness of the lines in this case is equal to the tolerances permitted. The chart is reduced to 20 times full-size by photography and printed on green glass, and not on vinyl. Because of the fine tolerances involved, the fragility of glass is accepted in this case, because of its ability to hold its size.

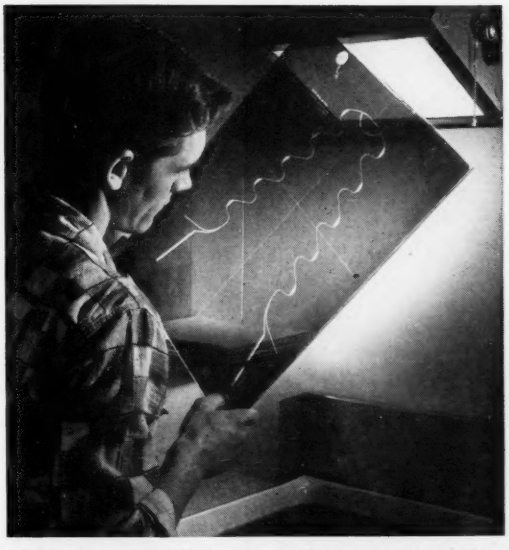
Each chart receives another check (in the Standards Room) on a specially designed fixture and its size recorded with microscopic exactness. If, on a later check, the chart shows any deviation from this size, it is rejected.

The charts are used on optical comparators. The blade curve chart is located with reference to datum lines on the comparator screen. A pair of styli follow the curves of the blade and cast shadows which appear on the screen 10 times full-size. The operator manipulates the shadows along the charted blade curves and is thus able to tell whether or not the form of the blade meets specified tolerances.

A similar comparator is used for inspecting blade roots, except that in this case the shadow of the root is magnified 20 times and projected on to the screen, where it should coincide with the lines of the blade root chart, also magnified 20 times. The varying thicknesses of the lines on the chart represent the tolerances acceptable in different areas.

A good operator can detect 1/10,000 in. in variation.

Draftsman uses a steel scale and a magnifying glass to check a blade root chart, accurate to 3/10,000 in.



Finished product. Darkroom assistant examines photo reproduction of a blade root chart on green glass.

Ideas round-up

The thicker you are the more you can lift?

If one assumes that the strength of a trained weight-lifter is proportional to the cross-sectional area of his limbs or torso, then it follows that his weight lifting ability is proportional to the 2/3 power of his body weight (according to a theory developed by M. H. Lietzke of Oak Ridge National Laboratory). This can be expressed by the equation:

$$W = KBw^{2/3} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where W is the weight that can be lifted in any one lift (or in a combination of lifts), K is a constant and Bw is the body weight. In order to test this relationship it is convenient to express equation (1) in logarithmic form:

$$\log W = \log K + {}^{2/3} \log Bw \ldots\ldots\ldots (2)$$

Then a plot of log W versus log Bw should be linear with a slope of approximately 2/3 or 0.67. Implied in the treatment is the assumption of constancy of form factor for weight lifters over the entire range of body-weight classes.

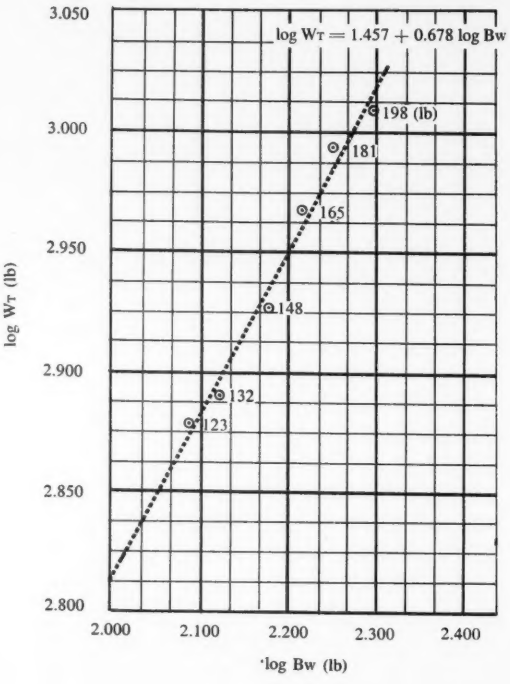
Weight-lifting championships are decided on the basis of the total weight lifted by an athlete in three different lifts: the press, the snatch and the clean and jerk. As a test of equation (2), a plot of the world record totals in the three lifts should be better than the records in any one lift, since taking the totals is an averaging process whereby the advantage one lifter might have over another (because of more favorable leverage in one lift) is counterbalanced in the other lifts.

The figure shows a plot of the log of the present world-record totals established at each body weight (W_T) against log body weight (Bw). As can be seen, the plot is linear as predicted. By the method of least squares, the best equation describing the points was obtained and is given as equation (3).

$$\log W_T = 1.457 + 0.678 \log Bw \ldots\ldots\ldots (3)$$

The slope of the line (0.678) is very close to the predicted value of 2/3 and hence seems to bear out the theory.

In making the plot, only the totals for the body-weight classes up to 198 lb were used, because the athletes in these classes are usually trained down to the listed body weight and hence carry very little excess



weight. It should be emphasized that the totals plotted are in no sense "ultimates" but will continue slowly to be improved. However, the slope of the log-log plot should continue to approximately 2/3. Also, the log-log plot can be used to determine the best weight-lifter at any time, since his total will fall the farthest above the line drawn by the method of least squares through all the records. At the present time it appears to be a toss-up between the middleweight (165 lb) champion Bogdanovski of Russia and the light heavyweight (181 lb) champion Kono of the U.S.A. (see graph). (213)

A spring isolator to lick vibration problems

A type of steel spring isolator (the Lo-Rez) is so named because of the very low resonance (or natural frequency) that it permits the isolated equipment to acquire. Extremely high efficiencies of vibration isolation are therefore obtained, even for the lower disturbing frequencies. Standard models have a natural frequency as low as 90 cycles per minute (static deflection equals 4⅜ in.), thereby affording exceptionally good vibration control for disturbances as low even as 175-200 cpm.

In order to make the most of a vibration isolator, it is necessary for it to be loaded to its rated capacity. This is why these isolators are made in a great variety of capacities, so that it is not necessary to use, say, a 400 lb isolator to carry a 250 lb load and thus seriously impair the isolation efficiency. For the smaller Lo-Rez isolators, 20 lb capacity increments are available, being stepped up proportionately for the higher capacity isolators.

Often certain peculiar vibration problems require special isolator characteristics either in the way of spring design, housing fabrication or material. In such cases, the isolators are custom-engineered.

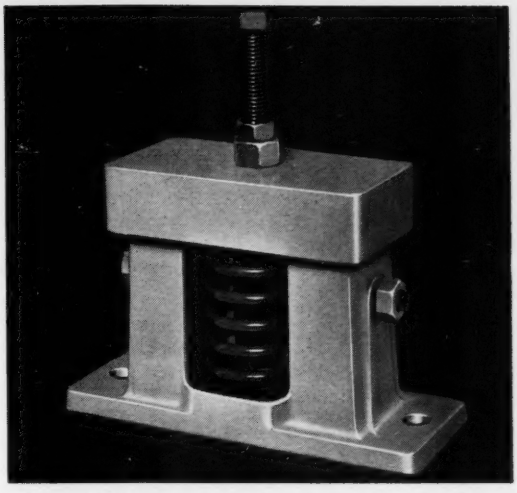
Neoprene damping pads inside the isolator provide lateral restraint. They are adjustable to provide for varying degrees of damping for traversing the resonant zones (in starting and stopping the isolated equipment) or for snubbing action in shock applications. The isolators provide flexible restraint and vibration isolation in all directions.

Load capacities range from 20 lb to 72,000 lb per isolator. The isolator shown is an LR1-M type having a load range from 200 to 1450 lb.

The table shows the isolation efficiencies obtainable with optimum selection of these isolators.

Disturbing frequency (cpm)	Isolation efficiency (%)
200	75
300	90
400	94.7
600	97.7
800	98.7
1000	99.2

High isolation efficiencies are obtainable also for shock applications. (214)



This model is LR1-M in the Lo-Rez line of isolators.

Tiny welds in stainless tubing

Toruseals are static pressure seals made by joining and welding the ends of tubing. They serve as metal gaskets in applications where a pressure-tight joint is needed.

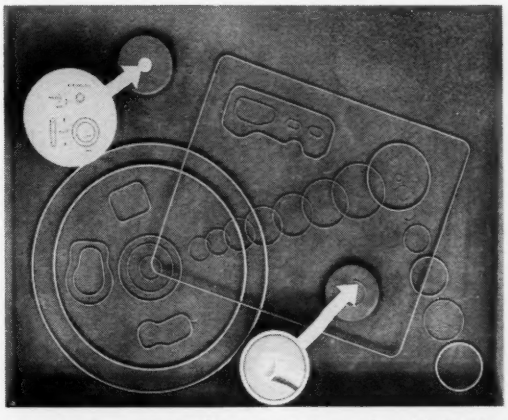
Uniformity of wall thickness is particularly difficult to maintain at the weld juncture. D.S.D. Manufacturing Co. achieves this by starting with tubing of close wall tolerance, then exercising special care in welding the ends and grinding off the external flash.

If the tubing wall is too thick, it will tend to crack when welded; if too thin, it will burn through. Varying wall thickness would also make it necessary constantly to adjust the welding machines. Uniform wall thickness is assured by the use of cold-drawn tubing to close tolerances on the outer diameter and the wall.

Type 321 stainless is most commonly used for the tubing. Produced to aircraft specifications, it must have a clean, bright OD and ID (to facilitate welding) and must be drawn from stock of closely controlled analysis.

The rings range in diameter from ¼ in. to 11 ft, round or shaped. The diameter is held to ±0.005 in. on any size, but can be held to +0.005, —0.000 when required.

After forming the rings, the weld area is given an X-ray and a dye penetrant inspection check. In addition, samples from each lot are tested to see if they will break at the weld.



Samples in various shapes and sizes of welded tubes.

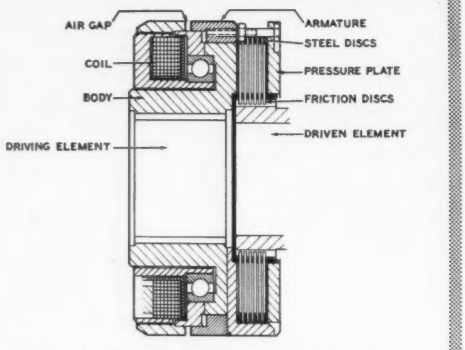
Toruseals can be used at temperatures from —300 to 1750F, vacuums to 0.002 microns and pressures to 10,000 psi for either liquids or gas. With a proper compression load, the rings give a perfect seal. (215)

Magnetic clutch with fast engagement and disengagement

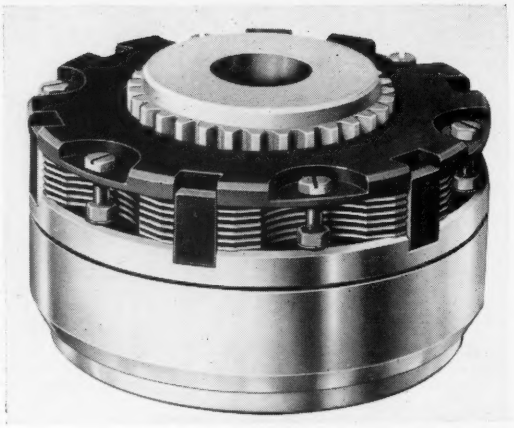
Design features of the Fawick Corporation magnetic clutch include comparatively short axial (and small radial) dimensions, complete isolation of the magnetic assembly from the integral mechanical parts, and compact, precision assembly of all component parts. It is furnished in stationary field or brush types and for either "wet" or "dry" operation.

Many operating advantages are claimed for it. First among these is its fast operating speed both in engagement and disengagement. "Decay time" and "residual drag" are reduced to an absolute minimum by effective isolation of the magnetic assembly from the clutch friction components.

The clutch provides complete torque control under



Clutch is shown in released position here.



This magnetic clutch is small radially and axially.

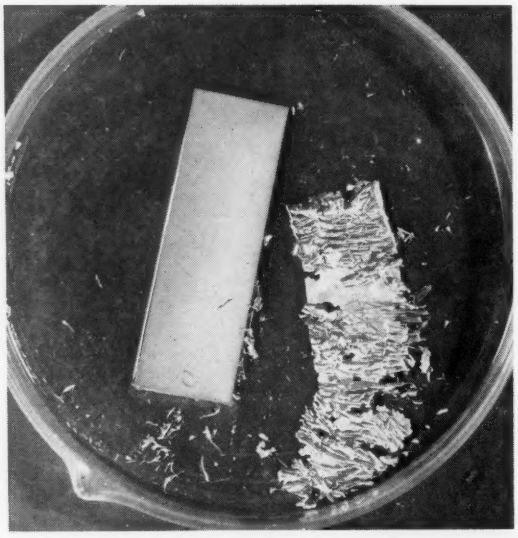
all rated conditions, through push buttons, relays or limit switches. It is easily adapted to modern machine tools and has a wide range of bore sizes. It is self-contained, and does not produce axial thrust on other machine parts. Action time is not affected by shaft speeds and the entire unit has high heat-dissipation characteristics. The clutch is available in sizes ranging from 2 to 13 in. for "wet" or "dry" operation. (216)

Rhodium plating without cracking and peeling

A rhodium plating process, said to produce compressively stressed deposits and to eliminate the curling, cracking and peeling common in conventional rhodium electroplate, is announced by Sel-Rex Corporation. Known as Rhodex-CS (compressively stressed rhodium), the process is expected to be of special interest to electrical and electronic manufacturers, long plagued with rejects of rhodium plated components caused by the high tensile stress characteristics of the metal.

The process has been subjected to extensive tests and experimentation. One of the most graphic of these tests entailed dissolving the basis metal from an object plated with conventional rhodium. In this instance, the rhodium disintegrated into small crystalline flakes and the edges curled away from the basis metal, thereby demonstrating its inherently high tensile stress. When an object plated with compressively stressed rhodium was subjected to the same test, it is reported that a continuous electroplated film remained, the edges curled toward the basis metal, thus indicating that the deposit was under compressive stress.

In addition to the obvious advantages of this new process, it is claimed that the process will materially increase the fatigue resistance of the metal over which it is deposited. (217)



Startling result of the experiment outlined at left.

The outer ring of this bearing is fractured

To increase the life and performance of standard metric series ball bearings, a new idea in bearing design and manufacture has been worked out by engineers at the Split Ballbearing Corporation.

In this fractured race technique, as it is called, the outer ring of the bearing is fractured at one point, so that it may be opened enough to introduce the maximum complement of balls. The advantages of this

Continued on page 46

New **WESTINGHOUSE Type 44**
Electrical Recording Instruments

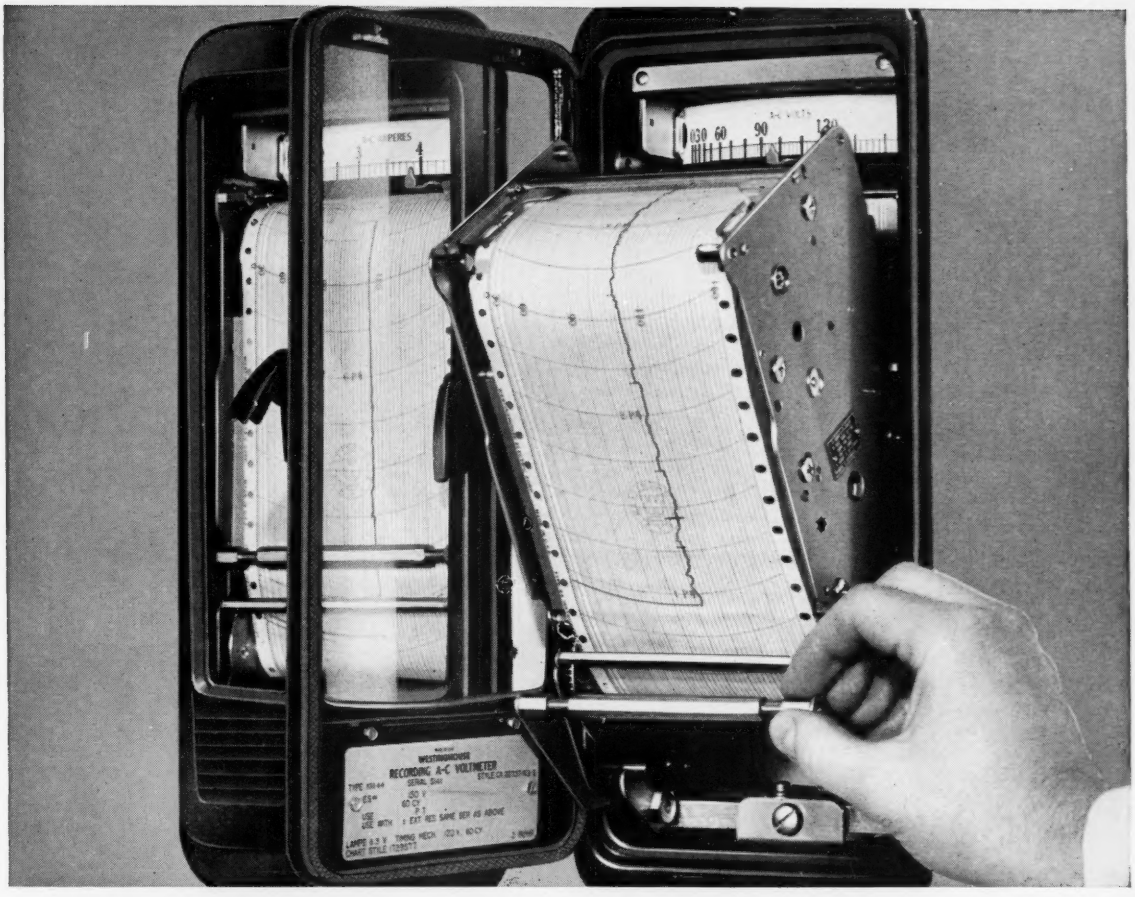
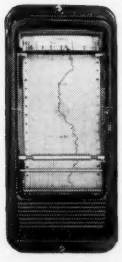


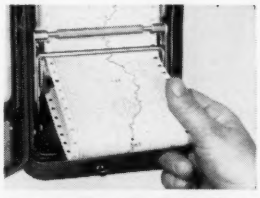
Chart tips forward—for service in seconds!



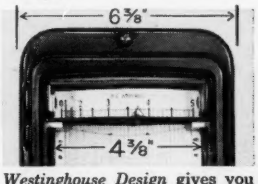
Never before a recording instrument so *easy* to service! You can reach every part of this Westinghouse new Type 44 from the *front*. And with the new "tip-to-you" chart mechanism, servicing the chart and ink system is a matter of *seconds*.

There are actually *26 good reasons* for choosing Westinghouse Type 44 Recording Instruments. Readability is exceptional; accuracy more than meets standards. Adjustable damping, compact design, high overload capacity are other advantages worth learning about.

Ask your Westinghouse representative for facts on the *complete* line of Westinghouse Recording Instruments. Or write Canadian Westinghouse Co. Ltd., Hamilton, Canada for Bulletin H-43-440.



Curtain Type Re-Roll allows convenient examination of chart record. Longer chart lasts up to 70 days.



Westinghouse Design gives you industry's highest ratio of actual chart width to exterior case width.

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method of construction (according to Split engineers) are:

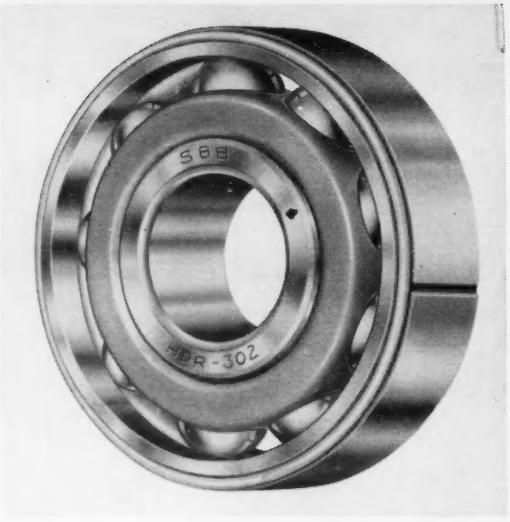
(1) No loss of thrust-load carrying capacity, as is experienced in the "loading-slot" or counterbored outer ring methods.

(2) Greater over-all performance. Having more balls in the bearing leads to increased load capacity and increased life of bearing.

(3) Simplification of ball retainer construction, by making it one-piece rather than multiple-piece.

(4) Basically new types of bearings, such as Type TWF thin-section bearing with integral shields and a full ball complement.

The fractured ring closes by its own resiliency and is secured by a circumferential holding wire or ring. It is claimed that the fracture does not weaken the bearing, as witness hundreds of proven applications. (218)

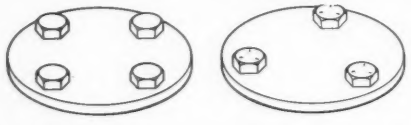


Bearing has no loading slot, no counterbored rings.

Where three heads are better than four

Three bolts spaced 120 deg apart around a common centre will provide as stable a joint as the conventional pattern of four bolts arranged symmetrically, according to fastener experts of Russell, Burdsall & Ward Bolt and Nut Company.

Savings in assembly (because there are fewer holes to drill and fill) make the three-bolt joint more desirable; savings in fastener cost are significant, too.



High tensile bolts rate 120,000 psi tensile.

Any holding capacity that is lost by using fewer bolts is made up for by using stronger bolts. This still permits cost savings. For example, either four ¾-in. bright cap screws or three ¾-in. high tensile bolts may be used to carry an 80,000-lb load safely. But three of the high strength bolts cost less than four of the cap screws.

High tensile bolts (identified by three radial dashes on the bolt head) have a high carbon content and are heat treated to get the increased strength. They are rated at 120,000 psi tensile.

Bright cap screws (identified by their bright finish) are produced to rigid dimensional tolerances and are rated at 68,000 psi.

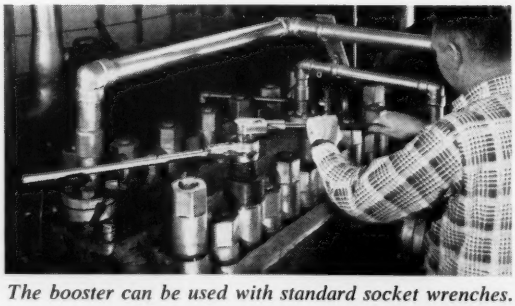
Machine bolts have a tensile strength of 55,000 psi. As the least expensive per piece, they are recommended where their strength is sufficient and the use of stronger bolts would not reduce their number. (219)

Big boost for turning force on a wrench

A general-utility tool which boosts wrench turning force four times, is announced by the X-4 Corporation. Used with standard sockets and wrenches, this rugged wrench accessory provides a 4 to 1 mechanical advantage for safe, easy loosening and tightening of heavy threaded parts.

The heart of the booster is a set of planetary gears, built into a simple concentric tool head. It can be completely dismantled in seconds for cleaning or lubrication, and is ruggedly built for torques up to 2,000 ft lb. Models TD 750 and TD 1000 are designed respectively for socket-drives of ¾ in. and 1 in.

The device has a wide application in the assembly



The booster can be used with standard socket wrenches.

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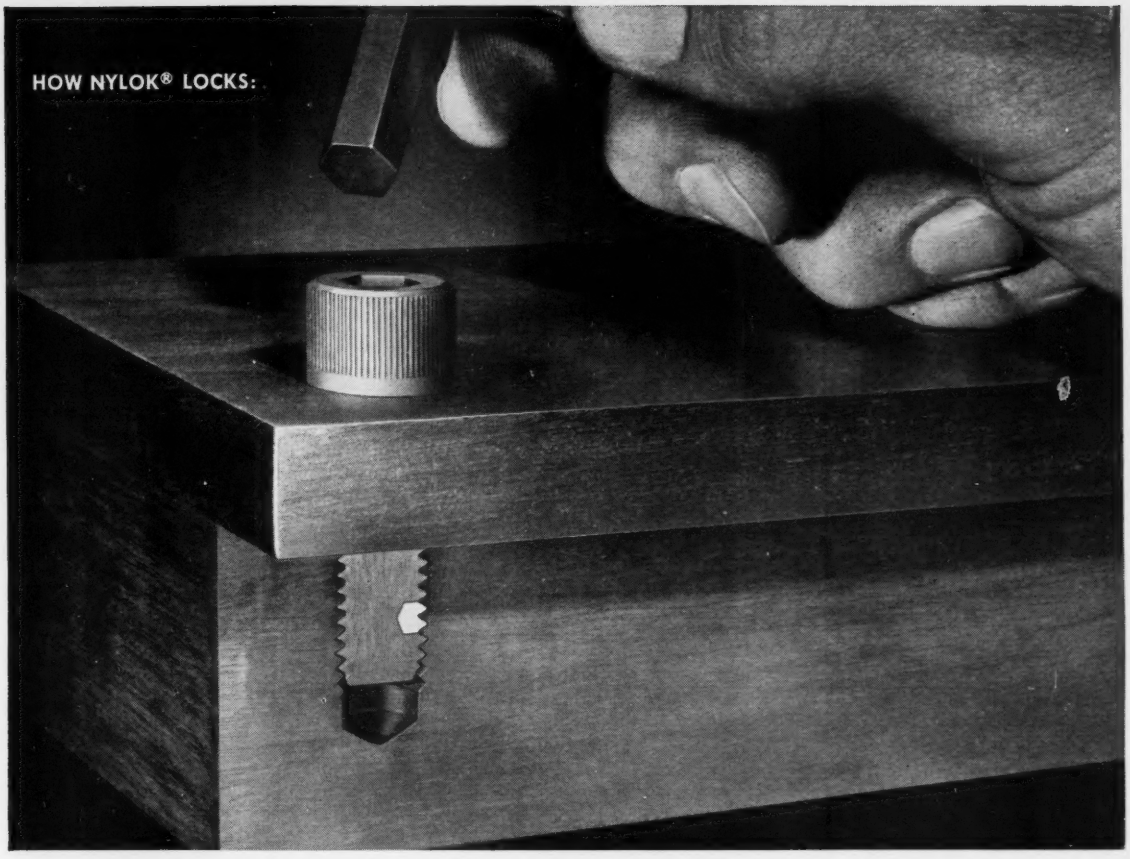
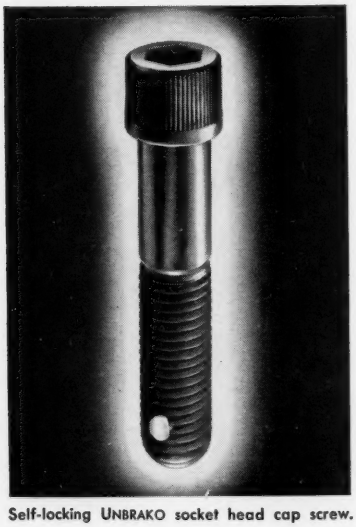


LOCKED! The tough, resilient nylon pellet keys itself into the mating threads. It forces threads together and locks the screw securely.

NEW—self-locking UNBRAKO socket head cap screws



Self-locking UNBRAKO socket head cap screw.

They won't work loose. And they simplify design and save production time.

UNBRAKO socket head cap screws are now available embodying the Nylok* self-locking principle. Nylok provides the first truly practical solution to the problem of making cap screws self-locking.

An UNBRAKO cap screw with Nylok is a single self-locking unit. No auxiliary locking devices are needed. Just thread the UNBRAKO into any tapped hole. *Seated or not*, it locks positively wherever wrenching stops. The tough, resilient nylon pellet forces mating threads together and holds tight. The screw will not work loose.

You save production time when you make products with self-locking UNBRAKOS. And you get greater simplicity in design with less bulk and weight. The number of parts you must assemble to achieve full locking action is reduced to the absolute minimum. Lockwashers under screw heads are no longer necessary. Costly wiring of cross drilled heads is eliminated. And in many cases you will save weight and mass by using shorter screws in tapped holes instead of drilling through and using nuts and lockwashers.

Self-locking UNBRAKOS are reusable. They have uniform locking and installation torques—with no galling or seizing on mating threads. They successfully withstand temperatures from —70° to 250°F. And, when screws are properly seated, the locking pellet also functions as a liquid seal.

A complete line of self-locking UNBRAKO socket screw products, in a wide range of standard sizes, materials and finishes, is available through your authorized industrial distributor. Technical data and specifications are detailed in Bulletin 2193. Write us for your copy today.

T.M. Reg. U.S. Pat. Off., The Nylok Corporation

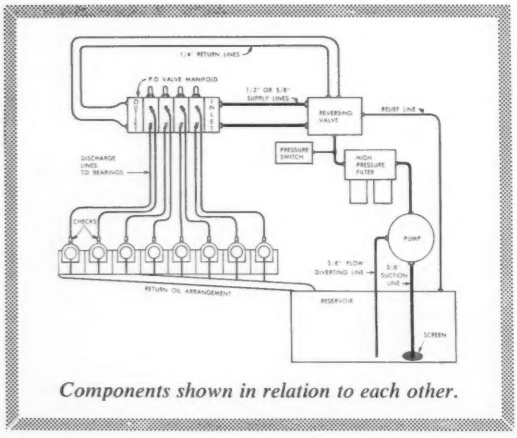
STANDCO CANADA, LTD.
193 Bartley Drive
Toronto 16, Ontario

and dismantling of high-torque threaded parts in transportation equipment, heavy plant or marine machinery, large piping systems and military equipment. The compact tool is convenient for use in the field, the shop or the plant, without any need for accessory power. It is ideal for close-quarter work and allows one man to do the work of four.

The booster consists of a compact drop-forged head of heat-treated chrome-molybdenum steel, a set of planetary gears and a removable reaction bar. The planetary system receives the square male fitting of a standard wrench handle. The planetary gearing, in turn, drives a standard socket fitting on the other side of the head, at a geared-down ratio of 4 to 1. All stressed parts of the tool are formed from specially heat-treated alloy steels. The entire geared head is taken apart by removing four machine screws. (220)

Oil system that monitors its own operation

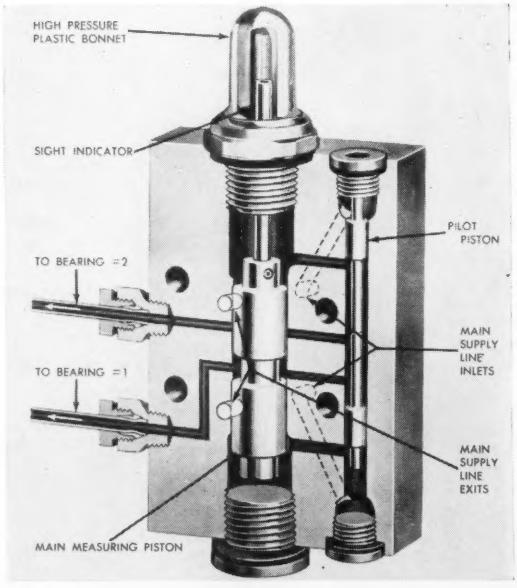
Designed to serve the lubrication needs of presses, automatic and semi-automatic machine tools, and so on, a new type of circulating oil system (known as Lubrival) employs the familiar Farval Corporation two-line principle of operation. The valves have individual sight indicators and feature the positive piston displacement method of feeding lubricant.



Components shown in relation to each other.

The system monitors its own operation through a pressure sensing mechanism to warn of clogged or broken lines in any part of the system. Circulating oil systems heretofore have failed to provide indication of broken discharge lines.

For operating flexibility, a variable delivery pumping unit permits a wide range of selection in the number of injections per minute applied to bearing points. There is no limit to the number of PD measuring valves that can be manifolded together to serve a piece of equipment, and the valves are manufactured in two capacities for interchangeable installation as required. In addition, since each valve is designed to serve two bearings, a simple, external cross-porting accessory can be attached at any time to merge two discharge ports into one. Simplicity of design and soundness of operating principle ensure that temperature-induced changes in oil viscosity have no effect on valve deliveries. (221)



Device to chase moisture from electronic equipment

Electronic equipment is seriously affected by excessive dampness, not only in warm, humid climates, but by condensation due to temperature changes in practically all climates. Thus, while dampness is acute in the tropics, it is present almost everywhere.

The danger from the use of highly concentrated sources of heat to correct dampness and condensation conditions is recognized by every electronics engineer.

A special device is therefore needed to meet the following exacting requirements: (1) the heating element must be long enough to distribute the heat evenly throughout the equipment to be protected, thus avoiding the danger of overheating some parts and underheating others: (2) it must be able to withstand the voltage surges

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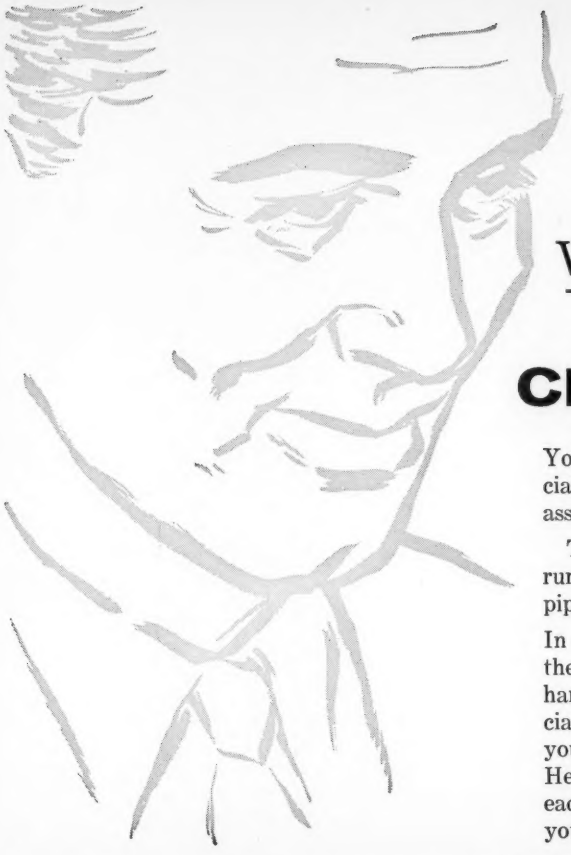

headers without headaches!

FABRICATED IN THE CRANE Pipe Shop

You're spared many a headache when Crane specialists take over the job of putting together piping assemblies like this header.

They save you time and trouble — and in the long run, money — as they build precisely, to applicable piping codes, and to your drawings and specifications.

In the modern Crane Shop are the tools and machines, the handling facilities and the specialized knowledge to make sure you get exactly what you want. Here, too, is the equipment to test each piece BEFORE it reaches you for final installation.

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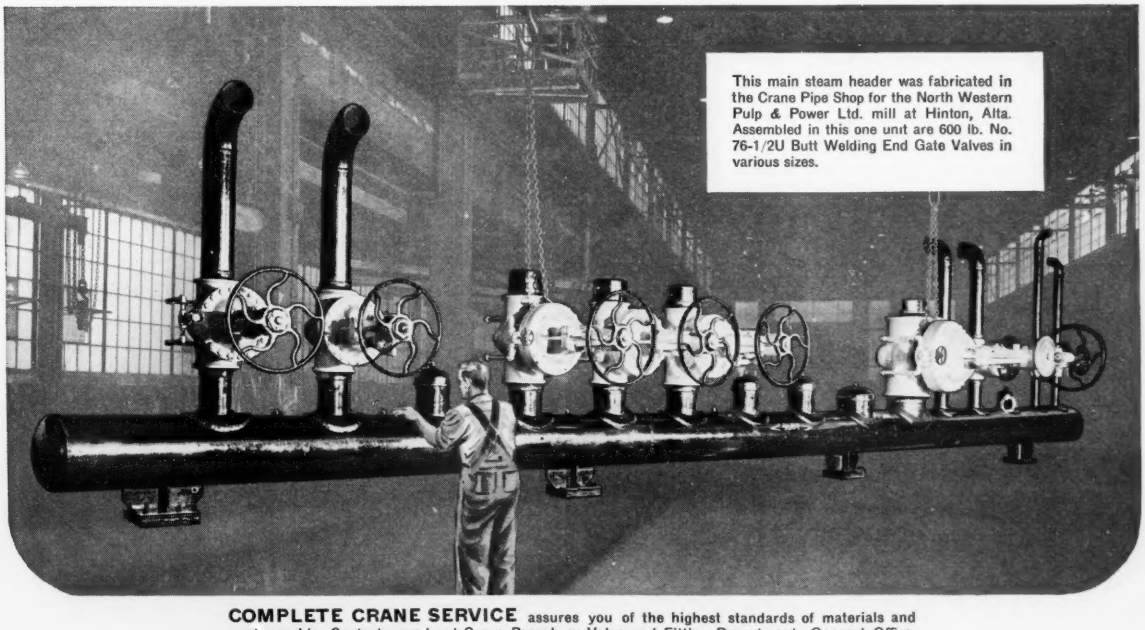
Bending • Flanging
Lapping • Swedging
Heat treating
Radiographic examination
Magnetic particle inspection
Hydrostatic testing inspection.



This main steam header was fabricated in the Crane Pipe Shop for the North Western Pulp & Power Ltd. mill at Hinton, Alta. Assembled in this one unit are 600 lb. No. 76-1/2U Butt Welding End Gate Valves in various sizes.

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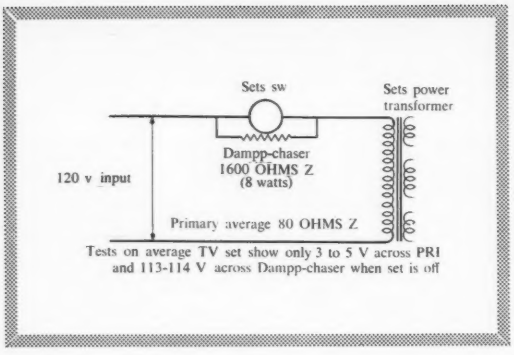
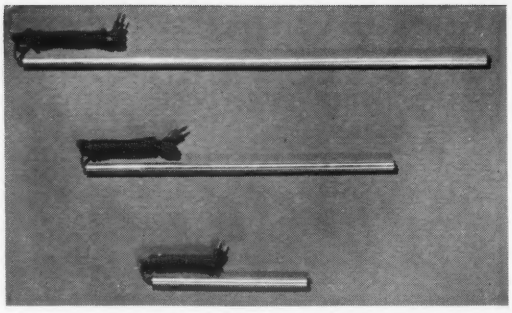

Sets sw
Sets power transformer
Dampp-chaser
1600 OHMS Z
(8 watts)
120 v input
Primary average 80 OHMS Z
Tests on average TV set show only 3 to 5 V across PRI
and 113-114 V across Dampp-chaser when set is off



Models come in three sizes, 18-in., 24-in. and 36-in.

(to which all electrical equipment is subjected) when in operation 24 hr every day, especially during lightning storms; (3) its wattage must be 4 to 6 watts per cu ft due to equipment being vented; (4) the heater must not be a personal hazard, even when it is in direct contact with components or wiring, and it must be tamper proof. After years of experiment Allen M. Foote, (the inventor) developed for **Dampp-Chaser Inc.** a unit that fulfills these exacting requirements.

By keeping equipment only 2 or 3 deg warmer than the room temperature at all times, condensation due to daily temperature changes can be completely eliminated. This can easily be done by using continuous, gentle, well-distributed electric heat. A 25-watt unit consumes only 18 kwh per month (an average of a penny a day).

Moisture cannot condense on surfaces unless they are at least a fraction of a degree cooler than the air around them. Condensed moisture causes rust and corrosion on metal objects and is absorbed by porous insulating materials such as wood, paper, bakelite, glass and porcelain, thus causing leakage, arc-overs and breakdowns.

By using a ¾-in.-diameter, 25-watt, 36-in. heater, the full benefit of the convection currents set up is quickly and continuously carried equally to all parts of the equipment, without hot spots. By circulation, the entire equipment is insulated from the ruinous effects of excess dampness and condensation by a blanket of warm, dry air in which the equipment is continuously bathed.

Other methods of removing excessive humidity (such as desiccants) are impractical unless the equipment is made air-tight. Even then, condensation can occur if the temperature change is sufficient. Since air-tight sealing is not possible when equipment is in use, there is only one answer; electric heat, properly applied.

A novel method of connecting the heater across the equipment's main power switch for automatic operation is shown. (222)

Pipe-wrappers try polyethylene instead of tar

A new scientific development is the changeover from the use of tar mixtures to polyethylene tape for wrapping oil and gas pipeline.

Until now, the anti-corrosion system has included the application of a primer and then a further coating of tar mixtures. The process required a large labor force, the transportation of heavy equipment (a tar kettle is as large as a room in a surburban home) and well-trained supervision. The system was open to difficulty as a result of human error, for a small hole in a pipeline can cause serious corrosion and necessitate digging up the line.

In contrast, the taping technique is strikingly simple. Polyethylene tape known as Polyken **(Kendall Company Canada Ltd.)** is wrapped by machine directly onto the pipeline without a primer. Twice as much pipe can be wrapped in a day, with about half the labor force. The tape is examined electronically before leaving the factory to reduce the chance of human error. A recent checkup on an actual project showed only one tiny pinhole in a mile of pipe. (223)

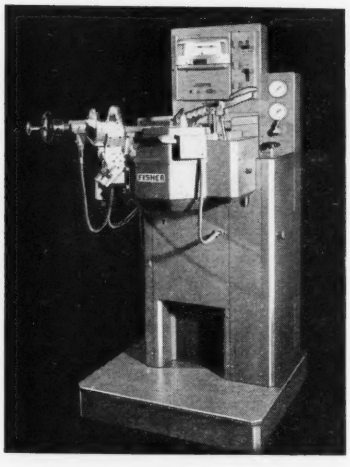
Polyken polyethylene tape being applied by machine to protect pipe against chemical action and electricity.

Welded Design

ADDS TO APPEARANCE AND STRENGTH

. . . CUTS COST

(Below) Original die casting machine made by Fisher Gauge Works, Peterborough, Ont.



NEW

NEW

NEW

New welded design (right) eliminates bar framework— **reduces number of component parts by 50%.**

Above are the "before and after" pictures of this compact die casting machine—see how redesign in welded plate has smoothed off surfaces, added rigidity and strength.

Sturdiness was a must — to provide greater protection for delicate instruments and to dispense with the need for bolting the machine to the operating floor.

Today, designers are alive to the advantages of welded steel construction over other methods — including casting. It saves time and materials . . . makes stronger, longer-lasting products . . . and provides many production short-cuts.

LINCOLN can help you with welded design

The new 11th edition Welding Procedure Handbook, available from Lincoln at cost will be a valuable addition to your technical library.

Ask for particulars of Lincoln's Weldesign Course arranged especially for Designers.

Write for your free copy of "Elements of WELDesign" — a guide to better products at lower cost. Issued quarterly.

Ask for a Lincoln representative to assist in conversion to welded design.

LINCOLN

LINCOLN ELECTRIC CO. OF CANADA LTD., 179 WICKSTEED AVENUE, LEASIDE (TORONTO 17), ONT.

New products & materials

Control valves

A series of high flow-capacity, instant-action poppet-type control valves, designed for use on large brake, clutch and other devices (especially on high speed applications) is announced by **Valvair Corporation.**

Simple in design and construction, the valves have only three moving parts. The air-cushioned poppet is operated by a standard PC solenoid pilot. Cast Navy M bronze valve bodies, stainless steel moving parts and Hycar sealing materials afford excellent corrosion resistance. (224)

Hydraulic pump

A compact low-cost wet-sump hydraulic gear-type pump is now offered by **Detroit Testing Machine Co.** Used for years in their own product line, it is now available to builders and users of equipment requiring a pump with a rated capacity of 0.5 gpm at 1,000 psi at 1,800 rpm.

This pump (the Detroit 1000) contains hardened steel and bronze gears, the latter ball-bearing mounted at both ends. All wearing surfaces are hard-chrome plated. Though initially produced for use within the reservoir, sealed adaptations for mounting externally have been made. (225)

Locking bolts

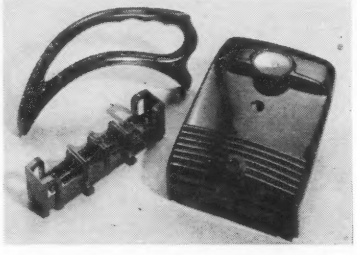
Anyone who has experienced the annoying drips and leaks from "weeping" bolts will be interested in the locking bolts made by **Buffalo Bolt Company.**

These locking bolts claim the attention of designers of equipment and machines where vibration ordinarily causes bolts to loosen and annoying leaks to develop. One, with a nylon pellet inserted in the thread, stays tightly locked even when not fully seated. Under vibration, shock or impact, it is an effective seal against gasoline, oil, alcohol and air, for use in automotive and machinery applications. Others are vibration-proof and self-locking without lock washers. A third group grips tighter under vibration, is oil and water-tight and provides excellent electrical contact. (226)

Phenolic moldings

Phenolic plastic is the ideal material for the three molded parts shown, each destined for rugged service. They benefit from its electrical insulating qualities, moldability, appearance, dimensional stability and resistance to heat, water and chemicals. Add to this the low cost of manufacture, and the advantages of plastic parts made of **Bakelite** phenolic molding materials are obvious.

Four classifications of phenolic plastics are available to meet the requirements of every designer: (227)



Three parts in phenolic plastics.

Dial gauge

Ruggedly constructed to permit rough handling, a new dial bench gauge offered by **Air Transport Equipment, Inc.,** has several outstanding features. Two 0.0001 in. dial indicators with revolution counters are supplied. The base is hardened and ground and the column is precision ground. The yoke permits measurements to 2 in. (228)

Cap nuts

A new line of cap nuts, fabricated from black nylon, is announced by the **Weckesser Company.** The nuts, knurled and slotted, may be used with rods or screws and also serve as knobs.

Nylon fabrication makes the nuts particularly useful in electrical installations, where high dielectric strength and resistance to corrosion are important. A range of sizes with American Standard threads includes 6-32, 8-32, 10-32 and ¼-20. (229)

Portable transformer

Variable transformer type 2PF10 made by **The Superior Electric Company,** incorporates many features making it ideally suited for laboratory, inspection, classroom and other applications where current requirements do not exceed 1.0 amp.

Housed in a compact casting only 3½ in. high and of 3½ in. diameter, it provides a light, portable variable a-c voltage source for a 0 to 132 volt, 1.0 amp, 132 va output from a 120 volt, 60 cycle, single phase input. (230)

Speed reducers

Four new and improved standard primary double-reduction units have been developed and added to the line of double-enveloping worm gear speed reducers available from **Cone-Drive Gears Division, Michigan Tool Company.** These primary units are available in centre distances of 2, 2½, 3 and 3½ inches. Coupled with the proper secondary, they provide reductions from 25:1 to 3500:1.

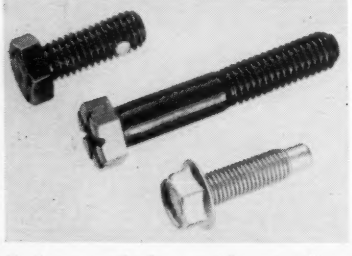
A wide range of torque and reduction combinations is thus provided. The units are available with worm over or under, or gear shaft vertical in either right-hand or left-hand or double extended shaft assemblies to meet almost any installation requirement. (231)

Ceramic seals

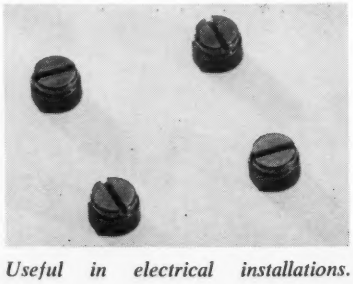
A new ceramic material for hermetic seal applications at high temperatures is now available from **Consolidated Electrodynamics Corporation.**

Known as Ceramicite, the compound bonds physically to most stainless steels. Its thermal expansion is similar to these metals. Seals embodying it have the exceptional ability to withstand severe physical and thermal shock without leaks or cracking.

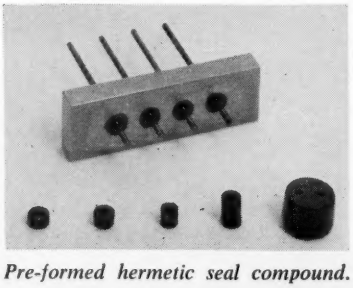
The heating required by the sealing process causes changes in the linear expansion properties of the materials. The result is a common coefficient permitting crystalline migration between interfaces of the materials involved during the cooling cycle. Thus, an actual molecular bond exists between the metal and the Ceramicite. This assures a highly reliable, leak-tight hermetic seal with excellent electrical characteristics in continuous operation at temperatures to 700F. (232)



Seal as you lock — without washers.



Useful in electrical installations.

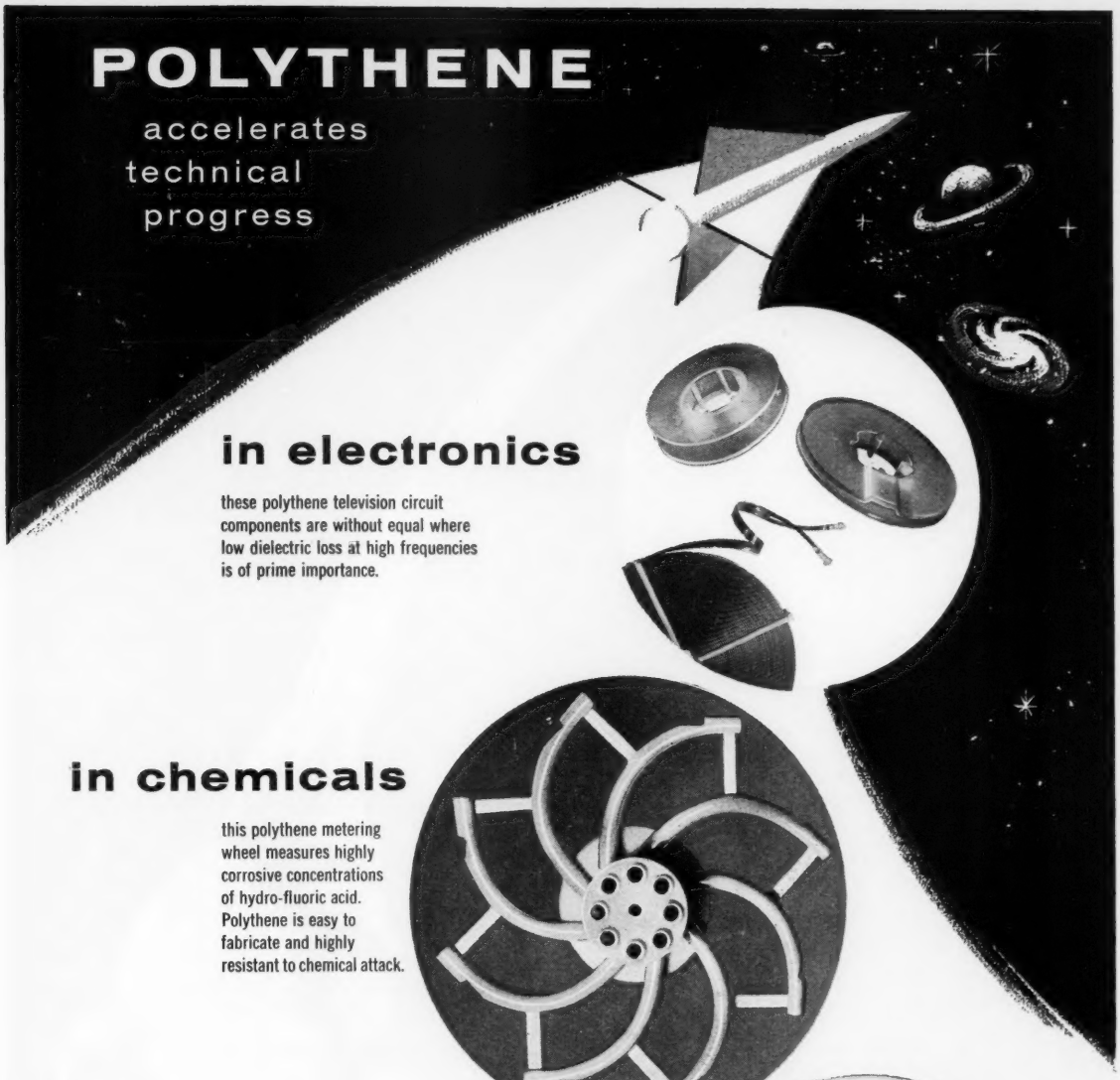


Pre-formed hermetic seal compound.

Continued on page 54

POLYTHENE

accelerates technical progress

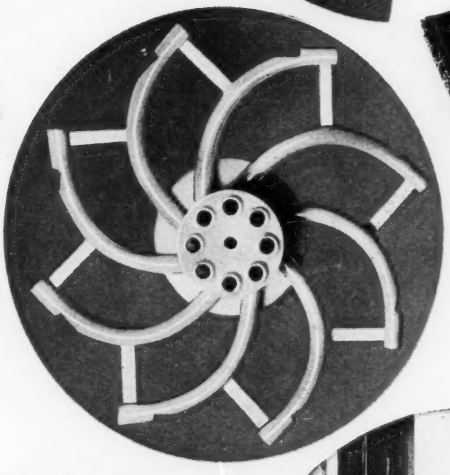


in electronics

these polythene television circuit components are without equal where low dielectric loss at high frequencies is of prime importance.

in chemicals

this polythene metering wheel measures highly corrosive concentrations of hydro-fluoric acid. Polythene is easy to fabricate and highly resistant to chemical attack.



in air conditioning

air filters packed with shredded polythene develop a high electrostatic charge, collect dust and dirt, yet wash clean quickly and easily. These filters are used in the new air conditioning system of the Sheraton-Mount Royal Hotel.

Designers in all fields!

UTILIZE POLYTHENE'S SPECIAL PROPERTIES! it's light, tough, non-toxic, chemically inert; has exceptional dielectric characteristics, remains flexible and strong even at sub-zero temperatures.

for further information and technical service, write:

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P.O. Box 10, Montreal,
suppliers of polythene
resin to convertors

C-I-L POLYTHENE

New products
continued

Tri-flux micromotors
Since the introduction (over six years ago) of the Type AY 6-pole tri-flux micromotors, about a million have been used in air conditioners, evaporative coolers, circulating units, direct drive blowers, fans and other applications.

Having proved itself in the U. S., it is now being manufactured in St. Thomas, Ontario, by **Redmond Motors of Canada, Ltd.**

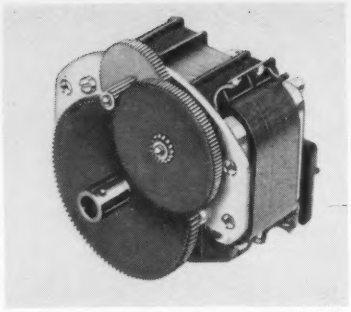
The completely redesigned, stronger and lighter magnesium stator core frame (die cast under high pressure), prevents shifting of the laminations during manufacture, handling and motor use. (233)

Miniature markers
A self-sticking miniature marker for identifying small diameter wires, miniature electronic components and subminiature circuits is manufactured by the **W. H. Brady Co.** The markers stick (and stay stuck) to any size wire 5/32 in. and smaller, including plastic coated wires.

The 3/16 in. x ½ in. markers come printed in numbers and letters to permit at-a-glance identification of small wires from any angle. Each marker has four bold black leg-ends printed on a white background. They resist most solvents, grease, dirt, oil and abrasion; stay in place during and after fungiciding. The adhesive remains pliable and durable at temperatures —300 F to +300 F. (234)

Underwater floodlight
Firemen, rescue workers and skin divers will welcome a new portable underwater floodlight, from **Crouse-Hinds Company of Canada Ltd.** Equipped with a No. 1 photo flood lamp, the 5¾-lb unit provides excellent illumination for seeing objects under 25 ft or more of clear water. Suitable for use under 100 ft of water, the Type DIV floodlight is 17 in. long and 13 in. across the reflector face. Completely waterproof, it has a molded rubber body, a cast aluminum reflector support, and a polished aluminum reflector. Its heat-resisting glass globe is protected by a specially plated steel wire guard. It requires normal 115-120-volt a-c service. (235)

Blind rivets
An oversize-diameter design has been added to the line of Conical Keystone Lock (CKL) blind rivets produced by **Huck Manufacturing Company.** These rivets are made 1/64 in. oversize on diameter to ensure hole filling and to produce a tight installation in dimpled sheets. They are available with countersunk heads in various sizes. (236)



Geared motor
A new catalogue describes the **Barber-Colman** type TYAZ-CE reversible geared motors. These are designed for use in servomechanisms, voltage regulators, combustion and industrial controls, and are available from 6 to 220 volts a-c with starting torques to 50 lb-in. (237)

Electrical Connectors
A new line of compact, lightweight electrical connectors for military and industral applications has been introduced by **The Pyle-National Company.**

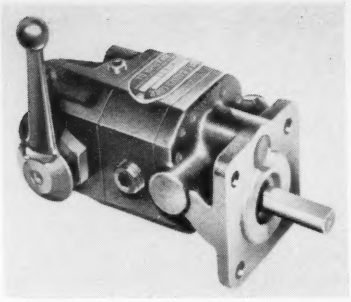
Known as the Pyle-Star-Line, these new plugs and receptacles are claimed to be impervious to water, moisture, oil, gas, dust, pressure, vibration and shock. The connectors meet and exceed class A, B, C and E of military specifications MIL-C5015B as well as NEMA requirements for power, lighting, control and coaxial circuits. (238)

Speed Detector
A newly designed, self-contained, speed detecting device from **Torq Engineered Products, Inc.** can be flange mounted in any convenient location. Known as the Syncro-Pak, it uses a centrifugal switch as the sensing element. It is dust tight and provides its own shaft mounted in ball bearings. The shaft can be coupled by any normal method to the shaft of the equipment to be protected or controlled.

This new unit can incorporate almost any required combination of sensing switches to detect overspeed and underspeed in a narrow or wide range. Once detected, the speed can be controlled by any practical circuitry. (239)

Titanium shafts
The jet-age metal, titanium, is now finding many new applications in industry, particularly where corrosion is a problem. **Mallory-Sharon Titanium Corporation** have demonstrated an outstanding commercial application, a pump shaft.

The pump must handle ferric chloride, a highly corrosive material used in making printed circuits. Pump shafts made of other special metal lasted only 45 min before corroding badly. The titanium, after months of service, is performing perfectly. (240)



Pump
At low cost the newly developed **Barnes Corporation** pump will give performance closely matching that of a high-priced variable displacement unit.

The pump is provided with a speed control valve set to handle, at wide open position, the maximum capacity of the pump, over a 90-deg movement output from full flow to zero can be obtained. The pump is provided with a standard speed control handle, and is available for flows up to 6 gpm.

Applications for this pump are numerous, such as: controlled flow for traversing the table of a small grinder; controlled flow for lubricating systems; controlled flow for reciprocating type cylinders in a number of applications. (241)

Industrial ladders
A new line of heavy-duty ladders designed especially for industrial use are announced by **Chesley-Sarnes of Canada Limited,** manufacturers of Featherlite aluminum ladders.

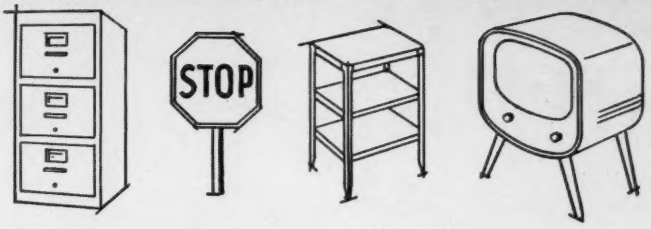
Made of heavy-section extruded aluminum, and reinforced throughout, they feature channel rail construction and are engineered to meet the strength and safety requirements of extra-long industrial extension ladders. According to the manufacturer, rung construction is integral with the side rails. Rungs are shouldered and locked into gusset plates which are riveted to the inside side-rails at eight points, and welded to the outside rails for added strength. Other features include self-adjusting safety shoes and large 1¼ in. diameter serrated rungs for secure, nonslip footing. (242)

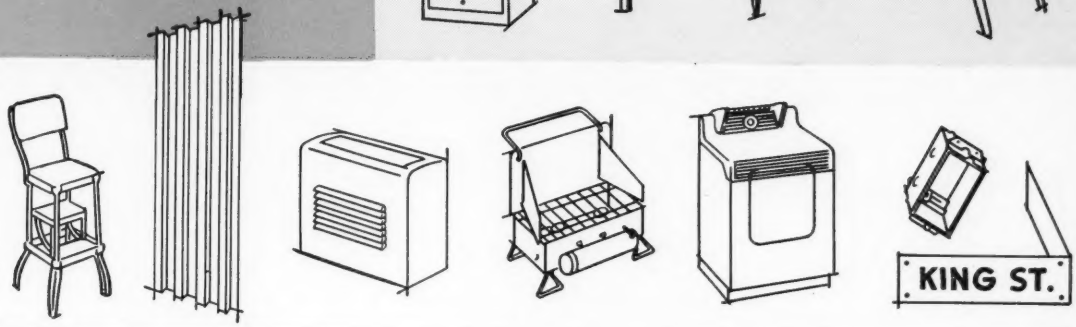
Remote control
A ball bearing, flexible, remote control was shown by **Control ex Corporation of America** at the recent Design Engineering Show.

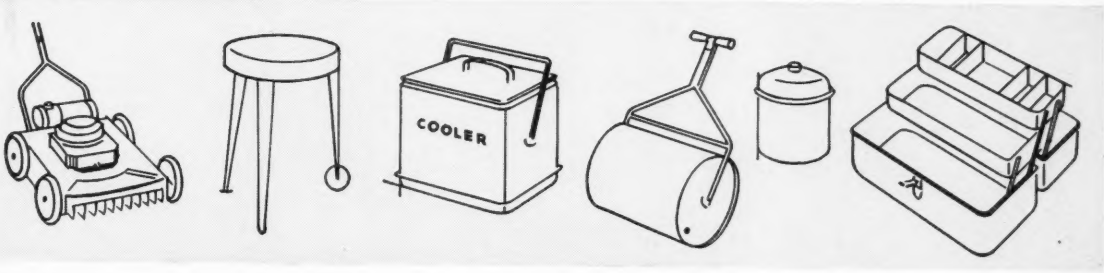
A stainless steel blade moving between two rows of balls transmits push-pull action. Regardless of load, this results in low friction and high efficiency.

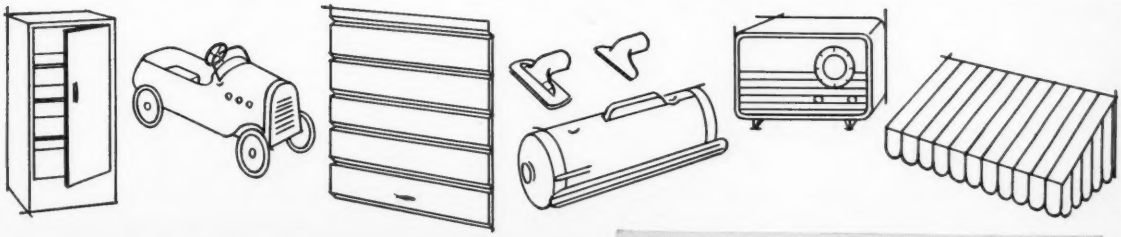
Constructed entirely of stainless steel, no lubrication is needed, and maintenance is thus eliminated. These controls are operating at temperatures down to —75F and up to 600F with the same high efficiency. (243)

IF YOU MAKE...









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A NEW STEEL PRODUCT BY

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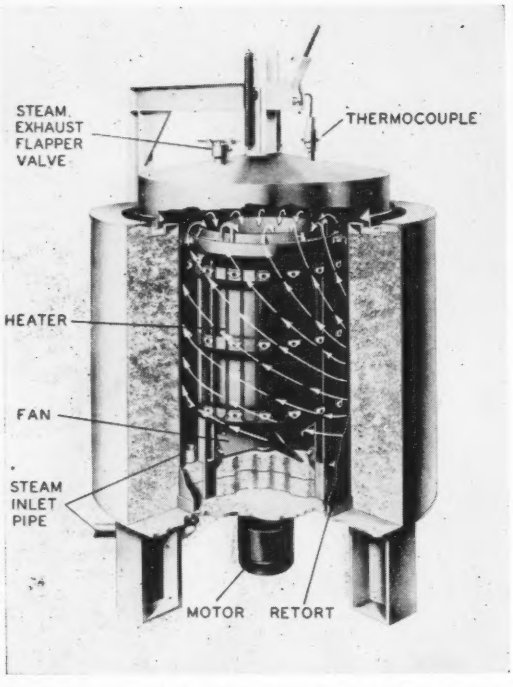
Better products at lower cost . . . that's the promise new SATINCOAT holds for Canadian manufacturers! Dofasco's latest zinc-coated steel takes decorative paints, enamels, inks without pre-treatment. And it **holds** a fine finish during the entire life of the product. The secret is in Dofasco's "continuous" galvanizing process where a ductile zinc coating is bonded so tightly to steel that it actually flexes with the base metal. Moisture cannot penetrate. Paint-lifting rust and corrosion have no place to get started! If you're looking for ways to cut manufacturing costs without sacrificing quality . . . look to SATINCOAT . . . Canada's newest fabricating steel! Samples and full details on request.

DOMINION FOUNDRIES AND STEEL, LIMITED
HAMILTON ONTARIO CANADA

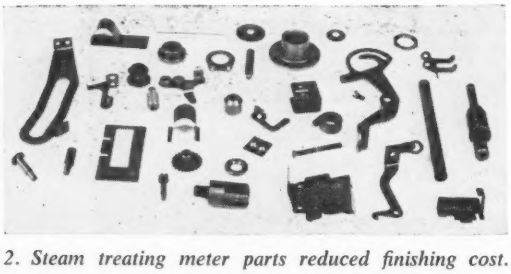
BEATS HIGH COST OF IMPORTED ELECTRO-GALVANIZED STEEL

The steam treating claim—big saving

The process can offer savings in tempering, annealing and finishing

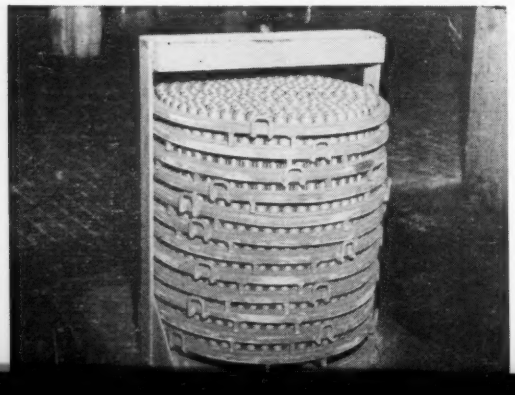


1. Basic components of a steam heat-treating furnace.



2. Steam treating meter parts reduced finishing cost.

3. Hardness of these powder iron parts was improved.



Many metalworking plants are making big savings in tempering, annealing, and stress-relieving by using steam atmosphere heat-treating. In furnaces specifically designed for this method by Leeds & Northrup Company, both ferrous and non-ferrous parts receive scale-free heat-treatment at temperatures up to 1250 F.

The finished product has superior wear resistance, longer life, better machinability and greater corrosion resistance.

In addition to these improved properties, steam treating can reduce (or even completely eliminate) many time-consuming finishing operations.

Fig. 1 identifies the basic components of a steam heat-treating furnace. After the work is loaded, the furnace is brought up to 650 or 750 F with air atmosphere. This preheats the work and prevents the condensation of steam on it.

Automatic controls hold this preheat temperature for 30 min while injected steam purges air from the work chamber. The load is then heated to soak temperature and held automatically for the specified time, with steam flowing through the furnace.

At the end of the soak, the work is either air-cooled or quenched in soluble oil. When handling non-ferrous materials which require lower soak temperatures, the furnace may be purged at a temperature as low as 400 F and the parts quenched in water.

As Fig. 1 shows, electric heating is obtained by a continuous run of heavy-gauge spiral wire surrounding the work space. A fan provides forced convection and uniform, rapid heating.

When hardened bolts and studs, precision steel castings, cold-headed bolts or deep-drawn parts are stress-relieved in a steam atmosphere, they come out clean and free from scale. During heat treatment, the steam forms a tightly adhering blue oxide coating which not only protects the parts but also makes an attractive final finish. Thickness of the coating (with a 30 min cycle at 1025 F) is about 0.0001 in.

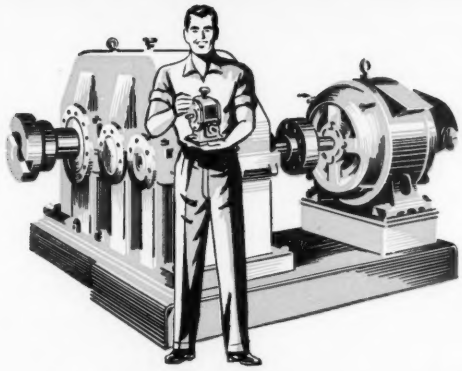
The oxide coating deposited on exposed surfaces during steam treatment has in itself a certain amount of resistance to corrosion. When the part is dipped in oil or other rust preventative, the porous nature of the oxide coating provides a highly retentive surface so that the corrosion resistance of such parts is usually equal to (or better than) parts treated by chemical oxidizing processes. In other cases, the uniform, blue-black surface obtained by steam treatment has proved a satisfactory substitute for plated parts.

Where parts require plating following heat treating, the oxide film is easy to remove with a short pickle, because it is of uniform composition and depth. One manufacturer of hardened steel bolts cut pickling time on bolts to be plated by 66%, through the use of steam treating.

Steam-treating of sintered powdered iron compacts

Continued on page 58

Gears



Rugged, quiet in operation and designed for extremely long service, Hamilton Gear Speed Reducers are favoured in a wide range of industrial and mining operations. Helical gear speed reducers—like the unit pictured above—have replaced herring-bone reducers in most applications because single helical gears require no centering and take the load evenly over the whole gear face despite any external thrust. These units can be equipped with a back-stop to prevent reverse rotation—for instance when used with an inclined conveyor or bucket elevator. These versatile Hamilton Gear reducers come in ratios from 2 to 1 up to 800 to 1, in single, double or triple reduction.

For further information write for Catalogue No. 113.

Hamilton Gear standard speed reducers are made in sizes ranging from units small enough to be carried easily by one man up to reducers weighing 18 tons.

Hamilton Gear and Machine Co., Limited.

HG-T-3-55

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In all sizes for every industrial application—

Flexible Couplings

Racks

Helical Gear Reducers

Helical Gears

Spur Gears

Bevel Gears

Herringbone Gears

Worms and Wormgears

Internal Gears

Wormgear Reducers

Table I Applications of Steam Atmosphere Heat Treating

Product	Material	Process
	Ferrous Metals	
Cams, bearings, valve tappets, pistons, piston rings	Cast iron	Controlled oxide coating
Saw blades, machine parts	Steel	Controlled oxide coating
Twist drills, taps, reamers, counterbores, punches	High-speed steel	Controlled oxide coating
Rotors and stators for hermetically sealed electric motors	Laminated silicon steel	Controlled oxide coating
Postage meter parts, sewing machine parts, guns, toys	Steel	Bluing
Gears, bushings, pistons	Powdered metal	Controlled oxide coating
	Nonferrous Metals	
Cosmetic cases, faucet spouts, radiator vent caps, 30 caliber shells	Brass	Annealing after progressive deep-drawing operations in fabrication
Valves, regulators, gas torch nozzles, fasteners, cosmetic containers	Brass or bronze	Stress relieving after machining
Clips, springs, electrical components	Beryllium copper	Precipitation hardening or aging
Instrument parts	Aluminum alloy	Solution treating

Steam treating continued

has as much as doubled their hardness and compressive strength. Resistance to wear improves, also, because the hard oxide partially fills the pores of compacts and offers its own resistance as parts wear down. Here, too, the ability of the film to store lubricants improves the wearing-in and corrosion-resistance of oil-dipped parts.

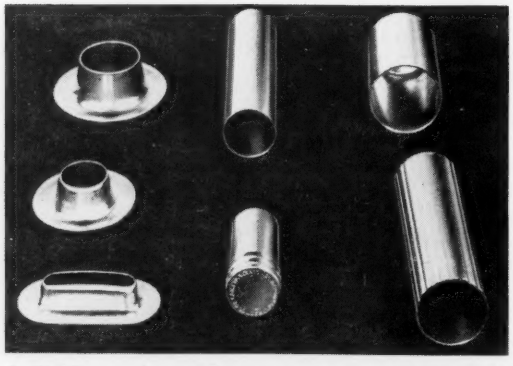
Drills, reamers, hobs, milling cutters and other high speed steel cutting tools on many applications hold their cutting edges 50 to 100% longer when steam-treated following tempering and final grinding. This increase can be as much as six times when the tools cut such extra-tough materials as heat-treated alloy structural grades of steel. The result is that fewer tools are needed and less time is required for changing and sharpening them.

In this case, also, the longer life is attributed to the tough, porous oxide film. Though micro-thin, the film insulates the tool from the machined part and prevents it from loading with chips "welding" near the cutting edge. The oil retaining properties of the oxide film give better point-of-contact lubrication during machining.

Brass and bronze parts (such as valve fittings, fasteners, cosmetic containers and cartridge cases) anneal and stress-relieve clean in a steam atmosphere. Often parts come out so clean that additional chemical cleaning is unnecessary. Parts to be plated require only a bright dip to remove the slight discoloration formed during steam treatment.

In many cases, steam-treating of brasses and bronzes eliminates pickling and other surface cleaning operations. One manufacturer of brass stampings realized a saving of 53% in pickling and annealing costs by the use of clean, steam-atmosphere without scale. For subsequent plating, they do not require pickling, except for a bright dip to remove the thin oxide film.

Solution treatment of aluminum alloys in steam gives a more uniform, more reflective surface as compared to the duller, heavy matte coating obtained in air. This means lower finishing costs on parts to be polished. One manufacturer of aluminum clutch arms saved up to 40% of the cost of subsequent buffing operations by the adoption of the steam atmosphere treatment. ★



4. Pickling and annealing cost was cut 53% on brass.

Book Department

Symposium on Solder (ASTM special technical publication 189). Soldering is one metallurgical operation that is probably better known and practised by more people than any other. The simplicity and ease of applying soft solder can, however, be very misleading, for the problems of soldering actually involve several branches of science, including chemistry, physics and metallurgy.

The 16 papers in this symposium explore these fields in detail. They illustrate the vital role of fluxes, solder composition and applications in getting satisfactory service performance from soldered joints.

Handbook of Engineering Tables. This book (published by the ASME) has been selected as one of the hundred best technical books of 1956. Edited by Dr. Jesse Huckert (professor of mechanical engineering at Ohio State University) it provides a compact source of basic data of metals engineering.

The handbook is designed to provide engineers and others with a ready reference to the properties and characteristics of metals. Most of the book consists of engineering tables in which is given information helpful to designers of gears, threaded devices and other mechanical parts.

An Introduction to Semiconductors by W. Crawford Dunlap Jr. The book provides a unified elementary survey of the field and covers basic concepts, properties of materials, methods of measurement and application. The author approaches his work almost entirely from a physical point of view so that even the section on devices emphasizes the mechanism and mode of operation.

The subject matter covered includes: crystals and their structure; theory of the solid state; imperfections in crystals; the electron theory of metals and semiconductors; properties of p-n junctions; and experimental measurements of semiconductors.

High Temperature Technology. Materials, Methods and Measurements. Edited by I. E. Campbell (Wiley). In recent years metals engineers, metallurgists, ceramists and chemists have engaged in extensive research in an effort to develop new materials of construction for service at very high temperatures. This book offers in succinct form the highlights of their research achievements to date. Thirty five outstanding workers in the field describe new materials, methods of production and techniques for measuring properties.

(Continued on page 63)

automation

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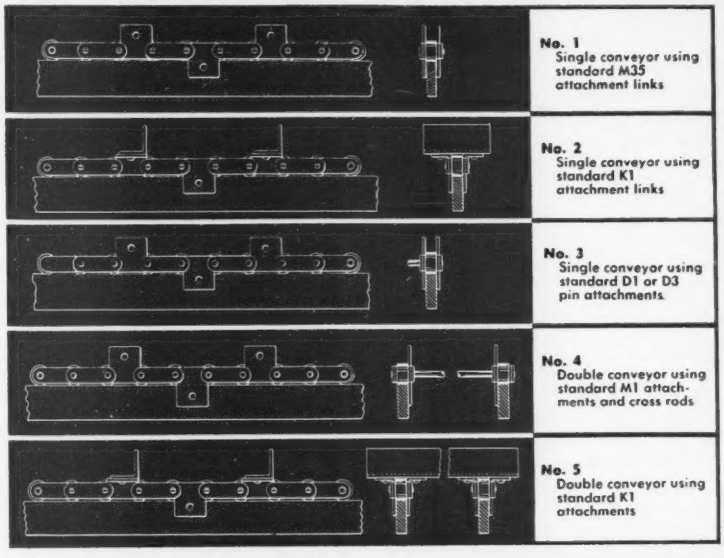
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Figure 8 Side Plates, Standard Rollers

Figure 8 Side Plates, Oversize Rollers

Straight Side Plates, Standard Rollers

Straight Side Plates, Oversize Rollers

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Sprockets for Double Pitch Chains can be furnished in either SINGLE TOOTH FORM OR DOUBLE TOOTH FORM, as shown on the right.

Double tooth cutting actually doubles the life expectancy of the sprocket.

Chain rollers contact only every other tooth. When these teeth become worn after long service, the sprockets can be advanced one tooth, thus permitting chain engagement on a new series of sprocket teeth.

Double pitch chains can be furnished in either Figure 8 or straight side plate type. with standard or oversize rollers.

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Quotes

Points from current papers and speeches

Hydraulic tubing

Tips on specifying tubing to ensure leakproof hydraulic systems are given in an article just reprinted by **Superior Tube Company.**

The article discusses the advantages of tubing over pipe for hydraulic lines, tubing material (including non-aging steel) and the care exercised in tubing manufacture. It concludes with a description of the five basic methods of tube bending and tabulates the minimum bend radii for hydraulic tubing for various diameters.

Mercury vapor lamps

With a light output two and a half times as much as large incandescent lamps (per unit of power supplied), mercury vapor lamps have a rated life of 6,000 hr as compared with 750 hr for large conventional incandescent lamps. The popularity of mercury vapor lamps is due to these advantages, as well as to the reduction of glare resulting from the higher mounting heights feasible with high-output lighting units. This information was given in a paper presented at the recent annual convention of the **Engineering Institute of Canada** by J. P. C. McMath (University of Manitoba) and Paul Shane (the Manitoba Power Commission).

Ultrasonic machinery

The technique of using high-frequency mechanical vibrations for machining brittle materials has assumed considerable importance in recent years. In this technique, a resonant electro-mechanical transducer is used to generate vibrations at an ultrasonic frequency. These are transmitted to the drilling tool through a mechanical focusing device designed to provide a sufficiently intense vibration at the tool face. The actual cutting agent is an abrasive powder dispersed in a liquid.

The growing interest in this ultrasonic machining technique has made it necessary to obtain an accurate assessment of the potentialities of the method. An article in **Phillips Technical Review,** Vol. 18, p 325 (by Neppiras and Foskett), deals with the fundamentals of the technique and gives a description of some ultrasonic drilling machines developed at the Mullard Research Laboratories.

Test specimen

In the development of new alloys (and in the acceptance testing of commercial heats of alloys for high-temperature service), it is usually necessary to determine their creep-rupture strength and their notch sensitivity. This is done by performing creep-rupture tests on smooth and notched bars of the material. Since the duration of these tests may be long, it is desirable to save time by reducing the number of tests. The notch sensitivity may vary for different positions in the lot of material (because of differences in history and composition), and it is therefore necessary for the notched test section to be taken from a position as close as possible to that of the smooth bar test section and for the heat treatment to be the same for both notched and smooth bars.

An article by M. J. Manjoine in the **ASTM Bulletin,** May 1957, p 35 describes a test specimen that has proved worthwhile in acceptance testing and in the development of new alloys and heat treatments.

Free-piston engines

A good general description and historical details of the free-piston engine gasifier are given in **Diesel Times,** March-April 1957.

Simple plastic theory

The very existence of steel structures is sufficient proof that present-day design methods are adequate to produce useful structures. However, this fact does not imply that the actual behavior of such structures is fully understood nor that the best use of the material has been made. The objective of a lecture given by Bruno Thurlimann (Lehigh University) at the National Engineering Conference (held under the auspices of the **American Institute of Steel Construction)** was to show a new approach to the design problem based on the actual mechanical properties of structural steel. With this method, the carrying capacity of a steel structure can be predicted within a fair degree of accuracy. Quite fortunately the method turns out to be simpler and shorter than present-day elastic methods.

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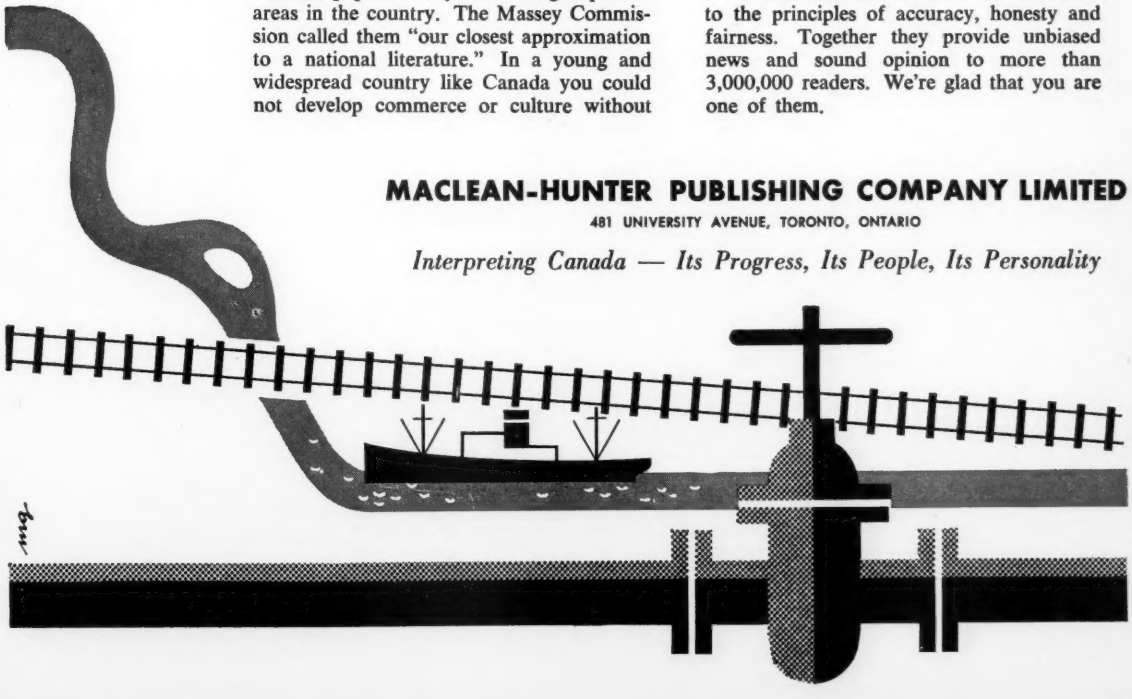

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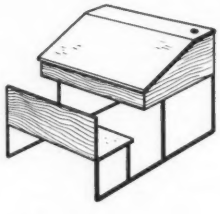

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Ferrous-clad metals

(continued from page 35)

expensive and stronger base metals have been used by the art and jewelry industries for many years. These materials are finding increasing use in industry for crucibles, electrical contact applications and similar uses.

Today, a large proportion of electrical contacts are fabricated from composite materials. Considerable savings in cost through precious metal conservation are obtained; the steel (and other backing materials) also provide desirable properties. For instance, a button type contact, with a steel or monel backing, facilitates projection welding of the contact to its supporting member.

While optimum cost may be the principal goal in the selection of a specific thickness ratio of precious metal to base metal, in many cases the backing material provides functional properties, such as spring characteristics, rigidity and magnetism.

Finally, mention should be made of brazing alloys clad to ferrous base metals. Cladding of this material is a rather noteworthy development of interest to production men. The separate handling of small pieces of brazing alloy is eliminated by fabricating parts from materials that have the brazing alloy pre-clad to the brazing surface. The brazing alloy and parent metal are bonded and rolled in a manner similar to the manufacture of other clad materials. The advantages of having the brazing alloy supplied as an integral part of the material is quite obvious; primarily it eliminates the separate fabrication of small pieces of brazing alloy, (as well as the handling of these pieces during the brazing operation) and decreases the number of surfaces to be joined.

Many of the ferrous metal combinations discussed have been produced to meet special applications; many other ferrous metal combinations will undoubtedly be manufactured and marketed as engineering demands them. A few additional combinations have been produced. One of these is nickel clad iron for devices based on the magnostrictive principle. In applications of this material, a clad metal sensitive to the magnetic field is substituted for one bearing heat sensitivity.

With all the metal combinations now possible in sheet, tubing and wire, it would be worthwhile to study present metal applications (as well as future product designs) to determine whether a clad metal will reduce material or fabricating cost, provide a combination of engineering properties otherwise unavailable, conserve a critical metal or improve the characteristics of a product. ★

Book Department

(continued from page 59)

Applied Metallurgy for Engineers by Malcolm S. Burton (McGraw Hill). This text seeks: (1) to develop the metallurgical principles involved in casting, metal working, welding, heat treatment and powder metallurgy; (2) to study these manufacturing processes from en engineering viewpoint, including the metallurgical factors that control selection of suitable processes, and the influence of the processes on the final products.

Emphasis is on the background of metallurgical science essential for the proper use of metallurgical manufacturing methods. Discussion of techniques and illustrations of industrial equipment is included, but is secondary to the presentation of metallurgical principles.

The balance between theory and engineering practice makes the text especially suitable for students who are not specializing in metallurgy. Enough theory is included to provide a sound metallurgy background for students in other branches of engineering.

Diagrams and photographs of equipment implement the theory and relate it to specific manufacturing methods.

Recently developed processes, such as shell molding, inert-gas-shielded metal arc welding and vibrationless mid-air forging, are considered. Special topics such as casting, metal working and welding) are given a balanced treatment with emphasis on both the metallurgical theory and processes. Questions and a list of references conclude each chapter. Cost of the book is $9.00.

Project Engineering of Process Plants by Howard F. Rase and M. H. Barrow (John Wiley & Sons). Written by men experienced in project engineering, this is the first book to recognize the new profession and to formalize the methods of executing a project used by all progressive chemical companies and engineering firms. It is also the first work devoted to process plant design written in accordance with modern techniques of project organization, planning and execution.

The authors approach the subject from the point of view of the project engineer — the specialist whose profession demands the technical know-how in all phases of engineering. It is his job to coordinate and supervise the design and construction of a modern plant.

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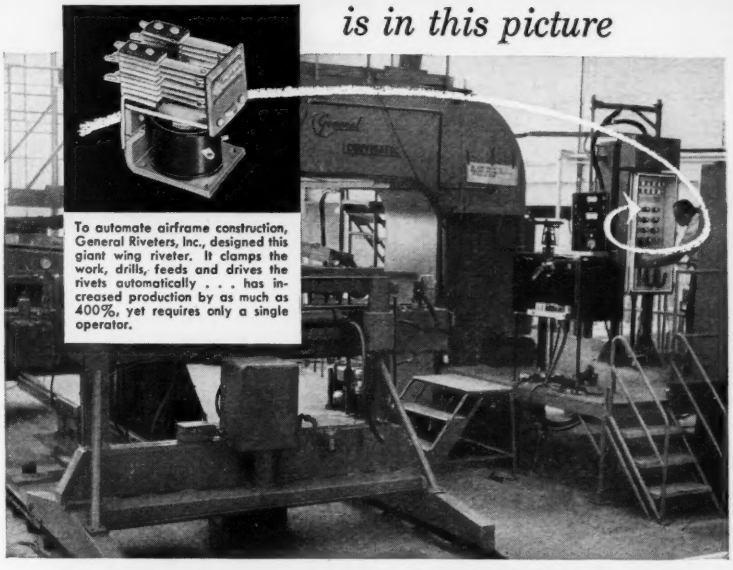

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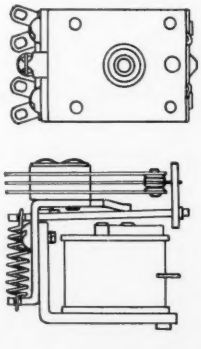

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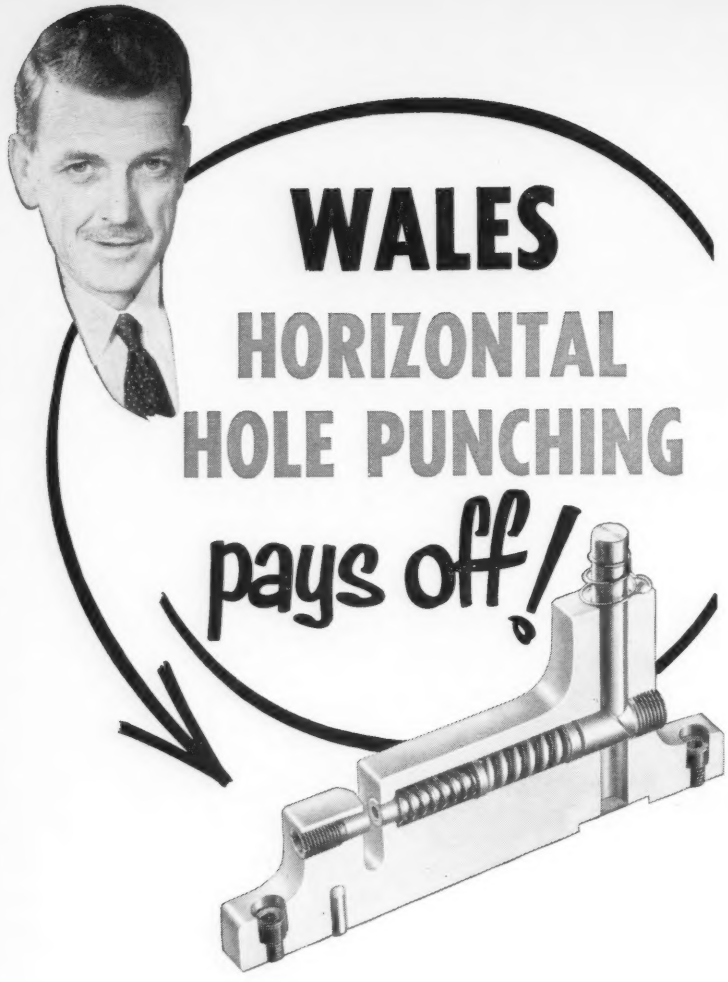

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Sleeve bearings

(continued from page 40)

will result in larger pieces of dirt being allowed to pass through the bearing without imbedding or scoring the shaft. Excessive amounts of dirt can convert a soft bearing into a hard lap, resulting in high temperatures and possible seizures. It may be necessary to increase the oil groove dimensions, to add spreader grooves or parting line chamfers, or to increase the horizontal clearance at the parting line to allow for more efficient cooling. This later installation (the eccentric bearing) is illustrated in fig 11. It allows the passage of additional oil without any increase in vertical clearance. Vertical clearance beyond 0.0022 in. results in an objectionable noise level, so most bearings make use of the eccentric design.

Having selected a suitable bearing of proper design and material from a knowledge of the bearing loads and decided on an appropriate clearance from the lubrication study, the next step is to be sure that the bearing maintains its shape when installed in an engine. To assure a tight fit between the bearing shell and the rod or crankcase bore, each half bearing is made longer than the bore in which it seats. The difference in length is commonly referred to as "crush." (See fig 12.)

Tightening of the cap bolts closes the gap, with the results shown therein. The bearing is now securely seated in the housing, but some deformation has taken place which may (or may not) be serious, depending on the design of the housing. If high inertia loads exist on the cap, there will be a tendency for the bearing to elongate vertically and to close-in at the parting line. To determine if an eccentric bearing should be used (or whether the housing design should be changed) bore distortion studies are made from actual measurements on loaded housings. Fig 13 shows the effect of crush on the bore of a connecting rod.

Further complications are introduced when a designer wants to reduce the weight of the engine by using a light metal (such as aluminum), especially if the equipment is to operate over a wide range of temperature. If, for example, a steel backed bearing were placed in an aluminum housing at room temperature and the engine expected to start at 65 deg F, the temperature rise might be as high as 320 deg F. Since the coefficient of expansion of aluminum is nearly twice that of steel, considerable attention would have to be given to such details as clearances, the mass of the housing, crush allowance and bolt strength in order to get satisfactory performance.

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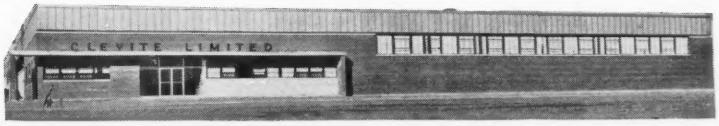

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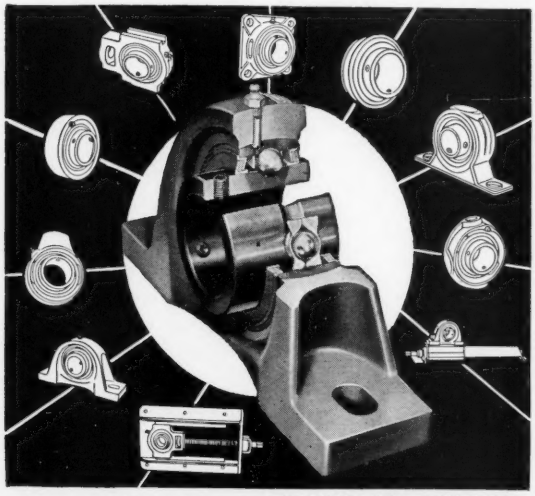

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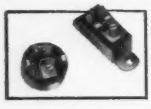
Maximum Temperature Control In A Minimum Of Space

These miniaturized temperature controls utilize the famous Fenwal THERMOSWITCH® principle. The outer shell is the activating element. That means short heat transfer path, built-in temperature anticipation, control stability and inherent thermostat sensitivity of less than 1°F. That's why they're ideal for such applications as aircraft, guided missiles, antennas, electronic equipment, radar, motors, computers, wave guides, crystal ovens, etc.

MIDGET. Shell is ¼" O.D. and is highly sensitive to changes over entire area. Single wire and two wire types; wide range from −50°F to 500°F; units which either make or break on temperature rise for control of gases, solids, liquids.



MINIATURE. Control within 2°F to 6°F is typical, even under 5G acceleration. Fully adjustable ranges of −20°F to 200°F or −20°F to 275°F. Hermetically sealed units −20°F to 200°F.

Get new, helpful facts on small-space temperature control and detection. Write for free bulletin MC-124, **Fenwal Inc., Factory Representative, Rousseau Controls, Ltd., 640 Decourcelle St., Montreal 30, P. Q., Canada.**

Fenwal Controls Temperature . . . *Precisely*

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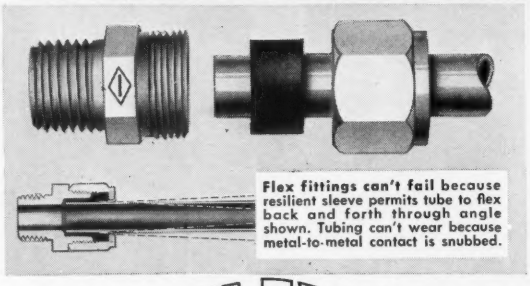

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are cushioned to end tube fitting failures!

- **Pressure-tight, leak-proof joints** on all seamed and seamless tubing, including scored tubing with surface defects.
- **Built to take punishment** — forged bodies on elbows and tees are tough, rugged. Sleeve withstands gasoline and oil . . . flexes in sub-zero or 250° F.
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- **Proved by extensive use** — ideal for trucks, tractors, diesel engines, heavy industrial machinery. Write for catalog No. 344.

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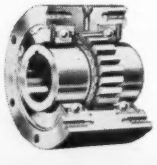
STANDARD AND SPECIAL SIZES } NO MEASURABLE BACKLASH LONG LIFE APPLICATIONS UNLIMITED



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A. ***Use ROTO-LOCK***

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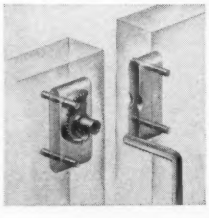

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- Used for air and water-tight seals
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- High resistance to corrosion and wear
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Applications include portable shelters, walk-in coolers, scaffolding, demountable furniture, partitions, air freight cold storage shipping containers, etc. Write for 40-page catalog on complete line. Ask for samples, too.

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Editorial

Brainstorming develops creativity

Brainstormers from far and wide gathered last month at the third annual creative problem-solving institute. It was held at the University of Buffalo and was co-sponsored by the Creative Education Foundation, the head man of which is Alex F. Osborn, author of the text book "Applied Imagination."

The speakers, many of whom were engineers, scientists or technologists, included such well-known personalities as Professor John Arnold (of MIT), Michael Montmore (who has lectured at McMaster University) and Willard A. Pleuthner who holds the strange-sounding title of "VP in charge of brainstorming" at his firm.

That properly conducted brainstorming sessions can have excellent results is borne out by some interesting developments at General Electric Co., details of which were given by David Purdy, who is in charge of their creative engineering program. As a result, we feel that Canadian engineers would be well-advised to investigate for themselves the technique of brainstorming.

What about it!

By now you will have received your copy of the questionnaire that is being circulated to find out the reaction of readers to the Components Application Guide in the July issue of Design Engineering.

As you know, we published the issue because you asked for it. We now want to find out—for future reference—whether you like the form it took and how you think it could be made even more useful to the design engineer.

It will take you only a few minutes to let us have this information and after all, it will help you too.

William Morse.

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INVESTIGATE THESE
HIGH TEMPERATURE

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WITHSTANDS HOT CORROSIVE LIQUIDS AND SLURRIES

Resists corrosion by hot sulphuric, sulphurous and phosphoric acid solutions. Also resists nitric acid solutions, nitrates, cupric, ferric and mercuric salts except chlorides. Considerably better resistance than stainless steels to pitting by sea water or stress corrosion cracking in chloride solutions.

These high Inco Nickel Alloys provide exceptionally good performance characteristics, particularly where extreme heat or highly corrosive conditions are a factor. In many applications they will long outlast competitive materials. The alloys shown here are available in most standard forms . . . and Inco Customer Service goes with them . . . to help you solve metal problems. Write us for complete information.

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ANNOUNCING!

Increased capacity ratings for Timken bearings

THE Timken Roller Bearing Company announces an increase in the capacity ratings of most series of Timken tapered roller bearings. Increases range up to 39%. Most are in the neighborhood of 10%. Some are negligible.

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3 Reasons for Increases

What led to these increases in Timken bearing capacities? Three things:

First, a careful review of more than 6,000 different laboratory studies of Timken bearing performance on fatigue life machines. From these exhaustive studies, conducted on an organized, scientific basis since 1924, we keep learning more and more about predicting bearing life.

Second, refinement in the method of analyzing these studies mathematically.

Third, a careful review of the life of millions of Timken bearings in the field.

How Much Can This Save *You?*

To find out how the new capacity ratings affect the types and sizes of Timken bearings in which you are interested, call your Timken bearing representative or write our Engineering Department. We'll be glad to work with you at the drawing board stage. The Timken Roller Bearing Company, Canton 6, Ohio, U.S.A. **CANADIAN PLANT:** St. Thomas, Ontario. Cable address: "TIMROSCO".

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